

DIAGNOSTIC REASONING IN  
PRIMARY CARE: EXPERIENCES OF  
MEDICAL STUDENTS AND  
FOUNDATION TRAINEES IN REAL  
AND SIMULATED ENVIRONMENTS

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## ABSTRACT

Sound diagnostic reasoning is essential for safe clinical practice. However, specific training in diagnostic reasoning has yet to be systematically integrated into the medical curricula across the UK. The development of appropriate training requires an understanding of the diagnostic process from the learners' perspective. The aim of this four-phase, mixed method study was to explore the diagnostic reasoning skills of senior medical students and Foundation doctors within the context of primary care, in order to enhance undergraduate training towards the point of graduation.

**Phase 1**, the main study, involved the filming of twelve 4th year medical students across 21 simulated primary care consultations. The students subsequently reviewed their filmed consultations and through semi-structured interviews with the researcher, reflected upon their diagnostic reasoning. Interpretative phenomenological analysis (IPA) was used to analyse the interview transcripts.

**Phase 2** followed the same cohort of medical students into real primary care settings in their final year. Two participants were filmed across four consultations followed by video-stimulated, reflective interviews, and this was again analysed using the IPA method.

**Phase 3** explored the diagnostic reasoning of qualified doctors in their foundation training. Two participants were filmed across six consultations using the same method and analysis as before.

**Phase 4** consisted of an online survey sent to all medical schools in the UK to enquire whether medical students in their penultimate and final years have views that are consistent with the main findings from *Phase 1*.

The findings of this study suggest that it is unlikely that Objective Structured Clinical Examinations (OSCEs) with standardized patients and checklist-style assessment could effectively test the diagnostic reasoning skill of senior medical students. Based on the data, the '*OSCE effect*' model has been proposed that could provide new insight into why previous studies have not found a strong correlation between OSCE performance and diagnostic reasoning ability. The present findings also suggest that it is time to revise the current conceptual framework for assessing clinical competencies in medical education by emphasizing the importance of cognitive skills. Finally, this study has identified a major challenge that medical students face during their penultimate year: for the first time in their training, students are expected to make explicit links between history taking, diagnosis and management by engaging in diagnostic reasoning. This transitional period could be the ideal time to integrate diagnostic reasoning training into their curriculum to better prepare students for future practice.

**Key words:** *diagnostic reasoning, medical students, Objective Structured Clinical Examinations, interpretative phenomenological analysis, primary care*



## TABLE OF CONTENTS

ABSTRACT.....	iii
TABLE OF CONTENTS.....	1
LIST OF TABLES.....	4
LIST OF FIGURES.....	5
ACRONYMS AND DEFINITIONS.....	6
ACKNOWLEDGEMENTS.....	8
AUTHOR'S DECLARATION.....	9
1 CHAPTER 1 – INTRODUCTION AND BACKGROUND.....	10
1.1 Introduction.....	10
1.2 The state of medical education in the UK.....	11
1.2.1 Societal and political changes that influenced the NHS.....	11
1.2.2 Changes in the medical curriculum.....	13
1.2.3 Simulated practice in medical education.....	17
1.2.4 Competency based assessment and Objective Structured Clinical Examinations.....	21
1.2.5 The medical education continuum.....	24
1.3 Diagnostic reasoning.....	27
1.3.1 Cognitive models of diagnostic reasoning.....	28
1.3.2 Expertise development.....	33
1.3.3 The role of context.....	39
1.3.4 Diagnostic reasoning in medical education.....	49
2 CHAPTER 2 – LITERATURE REVIEW.....	53
2.1 Introduction.....	53
2.2 The scope of the literature reviews.....	54
2.3 Medical trainees' diagnostic skills in primary care.....	55
2.4 Using simulation to explore diagnostic reasoning skills.....	69
3 CHAPTER 3 – METHODOLOGY.....	72
3.1 Introduction.....	72
3.2 Theoretical framework: Critical realism.....	73
3.3 Mixed method research.....	79
3.4 Interpretative phenomenological analysis (IPA).....	82
3.4.1 Reflexivity.....	85
3.4.2 Critique of IPA.....	87
3.5 Triangulation.....	89
3.6 The research problem and research questions.....	91
4 CHAPTER 4 – RESEARCH METHODS.....	93
4.1 Introduction.....	93

4.2 Research design.....	94
4.3 Pilot and Phase 1: The qualitative study of fourth year medical students’ experiences of diagnostic consultations in simulated primary care setting.....	96
4.3.1 <i>Research Governance and Ethics</i> .....	96
4.3.2 <i>Local medical school curriculum</i> .....	97
4.3.3 <i>The simulated surgery setting</i> .....	100
4.3.4 <i>Video-stimulated recall</i> .....	101
4.3.5 <i>Participant recruitment and data collection</i> .....	104
4.4 Phase 2 and Phase 3 – The qualitative study of final year medical students’ and Foundation doctors’ experiences of diagnostic consultations in real primary care setting .....	105
4.4.1 <i>NHS Ethics and Sponsorship</i> .....	105
4.4.2 <i>Participant recruitment and data collection</i> .....	108
4.5 Phase 4 – Survey exploring penultimate and final year medical students’ experiences of OSCEs and real primary care consultations .....	110
4.5.1 <i>Research Governance and Ethics</i> .....	110
4.5.2 <i>Participant recruitment and data collection</i> .....	111
4.6 Data Analysis .....	112
4.6.1 <i>The Interpretative Phenomenological Analysis (IPA) process</i> .....	112
4.6.2 <i>Data analysis of the survey data</i> .....	116
5 CHAPTER 5 – FINDINGS .....	117
5.1 Introduction .....	117
5.2 Participants.....	118
5.2.1 <i>Phase 1</i> .....	118
5.2.2 <i>Phase 2</i> .....	119
5.2.3 <i>Phase 3</i> .....	119
5.2.4 <i>Phase 4</i> .....	119
5.3 Phase 1 - IPA findings.....	120
5.3.1 <i>The OSCE effect</i> .....	121
5.3.2 <i>Diagnostic reasoning</i> .....	135
5.3.3 <i>Challenges in consultation skills</i> .....	157
5.4 Phase 2 – IPA findings.....	163
5.4.1 <i>Diagnostic reasoning</i> .....	164
5.4.2 <i>Training and preparedness for practice</i> .....	175
5.5 Phase 3 – IPA findings.....	180
5.5.1 <i>Diagnostic reasoning</i> .....	181
5.5.2 <i>Strong consultation skills</i> .....	198
5.5.3 <i>Patient-doctor dynamics</i> .....	202
5.6 Phase 4 – Survey results.....	208

5.6.1	<i>Descriptive analysis – Penultimate year medical students</i>	208
5.6.2	<i>Descriptive analysis – Final year medical students</i>	213
5.6.3	<i>Comparative analysis of penultimate and final year students</i>	219
6	CHAPTER 6 – DISCUSSION AND CONCLUSIONS	222
6.1	Introduction	222
6.2	Discussion of the findings	223
6.2.1	<i>Diagnostic reasoning: from medical school to the real world</i>	223
6.2.2	<i>The ‘OSCE effect’</i>	242
6.3	Practical implications	251
6.3.1	<i>Lessons for curriculum design</i>	251
6.3.2	<i>Assessment of diagnostic reasoning</i>	264
6.4	Theoretical implications	272
6.4.1	<i>Clinical competency assessment in medical education – revising the Miller pyramid</i>	272
6.5	Limitations of findings	275
6.6	Future directions	281
6.7	Concluding remarks	282
7	REFERENCES	283
8	APPENDICES	300
A.	Interview guide for the video-stimulated interviews	300
B.	Consent Form for medical students in Phase 1	301
C.	Participant information sheet for Phase 1	302
D.	Consent form for medical students and junior doctors in Phase 2 and 3	304
E.	Participant Information Sheet for medical students and Foundation Trainees in Phase 2 and Phase 3	305
F.	Patient consent form for Phase 2 and Phase 3	307
G.	Patient information sheet for Phase 2 and Phase 3	308
H.	Presence of data extracts within individual transcripts representing themes and subthemes to highlight the divergence and convergence of data	311
I.	Online questionnaire for Phase 4	312
J.	Survey questions organized into themes	316
K.	Independent-Samples Mann-Whitney U Tests	31

## LIST OF TABLES

<b>Table #</b>	<b>Title</b>	<b>Page</b>
Table 1	Approaches to simulation: advantages and weaknesses	19
Table 2	Literature review key words focusing on the diagnostic skills of senior medical students and newly qualified doctors relating to clinical problems that are relevant to a primary care setting	55
Table 3	The summary of articles investigating the diagnostic performance of senior medical students and newly qualified doctors	57
Table 4	Literature review key words focusing on the use of simulation to explore diagnostic skills in medical education relating to clinical problems that are relevant to a primary care setting	69
Table 5	The participant list of Phase 1 of the present study	118
Table 6	Themes based on the Year 4 interviews	120
Table 7	Themes based on the Year 5 interviews	163
Table 8	Themes based on the interviews with Foundation trainees	180
Table 9	Students' perception of balancing thinking and listening during OSCE consultations	219
Table 10	Students' perception of discrepancy between questions asked during OSCEs and real consultations	221
Table 11	Summary of main findings from the IPA studies	241

## LIST OF FIGURES

<b>Figure #</b>	<b>Title</b>	<b>Page</b>
Figure 1	Miller's pyramid of clinical competency assessment	22
Figure 2	Dual-process theory of diagnostic reasoning	30
Figure 3	Example of forward reasoning strategy	36
Figure 4	Diagnostic strategies used in primary care	46
Figure 5	The screening process for the literature review focusing on the diagnostic skills of senior medical students and newly qualified doctors	56
Figure 6	The screening process for the literature review focusing on the use of simulation to explore diagnostic skills in medical education	70
Figure 7	Ontological foundations of critical realism	76
Figure 8	The mixed-method design of the present study	80
Figure 9	The detailed research design of the present study	94
Figure 10	Curriculum outline of the local medical school	97
Figure 11	The timeline for Phase 2 and Phase 3 of the present study	106
Figure 12	Medical students' reliance on checklists	228
Figure 13	Changes in diagnostic reasoning based on the IPA findings	240
Figure 14	The 'OSCE effect'	248
Figure 15	Terminally branching schema	259
Figure 16	Cognitive psychological framework for behaviour: Theory of planned behaviour	269
Figure 17	Performance orientation during OSCEs	270
Figure 18	Mastery orientation during OSCEs	271
Figure 19	The cognitive and behavioural elements of Miller's pyramid	272
Figure 20	The revised 'Miller's pyramid' for clinical competency assessment that incorporates diagnostic reasoning	274

## ACRONYMS AND DEFINITIONS

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**Analytic reasoning (AR):** Also known as a System 2 thinking, which is characterized by slow, effortful, controlled reasoning processes (Evans, 2008).

**Backward reasoning:** The clinician starts by having a hypothesis in mind, then collects data based on that hypothesis in order to see whether there is sufficient evidence for it in the patient's medical history (Arocha et al., 2005)

**Clinical reasoning (CR):** A broad term that refers to all the different types of reasoning processes associated with clinical practice, including narrative reasoning, ethical reasoning, collaborative reasoning, conditional reasoning, interactive reasoning and diagnostic reasoning (Higgs & Jones, 2008).

**Diagnostic reasoning (DR):** The thinking process of the clinician involved in the diagnosis and management of a clinical case; it is part of the wider category of clinical reasoning.

**Epistemology:** The study of knowledge and what constitutes as knowledge (Cleland and Durning, 2015)

**Forward reasoning:** The clinician moves from data through the use of semantic qualifiers and algorithms towards the hypothesis (Pelaccia et al., 2011)

**Foundation Program:** A two-year postgraduate medical training programme, introduced in 2005. Foundation year 1 replaced the old preregistration house officer year, and foundation year 2 replaced the first year of senior house officer training

**Foundation Year 2 trainee (FY2):** A postgraduate medical trainee in the second year of the Foundation Training Program.

**General Medical Council (GMC):** A statutory body established in 1951 to ensure and promote safe healthcare practices in the United Kingdom (UK) (Finch, 1958).

**General practitioner (GP):** A medical professional working in primary care.

**Health Research Authority:** A health authority of the NHS, set up in 2012 in order to promote and protect the interests of patients in health research and to simplify the regulation of research (replacing the National Research Ethics Service).

**Heuristics:** Cognitive shortcuts that enable faster decision making

**Interpretative Phenomenological Analysis (IPA):** IPA is a qualitative research approach that aims to offer insights into how people in a defined context make sense of a certain phenomenon (Chan et al., 2010, Smith et al., 2009)

**Metacognition:** A higher-order cognitive process that involves becoming aware of and analysing one's own cognitive processes

**Multiple Choice Questions (MCQ):** An exercise where individuals need to choose the most suitable answer to a question from a set of pre-defined answer options.

**National Health System (NHS):** The public health services in the UK, established in 1948 with the aim of providing comprehensive healthcare (Ham, 2009)

**Non-analytic reasoning (NAR):** Also known as a System 1 thinking, which is characterized by rapid, effortless, associative reasoning processes (Evans, 2008).

**Objective Structured Clinical Examination (OSCE):** *“A timed examination in which medical students interact with a series of simulated patients in stations that may involve history-taking, physical examination, counselling or patient management”* (Harden and Gleeson, 1979)

**Ontology:** The study of existence and it is concerned with what constitutes as reality (Cleland and Durning, 2015)

**Primary care:** *“Comprehensive health care for individuals and families in the community provided through an integrated network of services covering the treatment of common illness and injuries, maternal and child health problems, the care and rehabilitation of people with long- and short-term handicaps and disabilities, and health education. In the UK the delivery of primary care is via GP services, PCT medical services, and alternative provider (e.g. private health company) medical services, as well as NHS walk-in centres and other community services outside the hospital service”* (Martin and McFerran, 2014)

**Problem Based Learning (PBL):** A curriculum design that emphasizes learning through the experience of discussing and solving open-ended problems in small group settings.

**Secondary care:** *“Health care provided by hospital clinicians for a patient whose primary care was provided by the general practitioner or other health professional who first diagnosed or treated the patient. Secondary care cannot be accessed directly by patients. For example, a general practitioner who assesses a patient with an unusual skin condition may refer the patient to a dermatologist, who then becomes the source of secondary care”* (Martin, 1998)

**Semantic qualifiers:** Pairs of opposing adjectives that can help narrow down the list of possible differentials (Bordage, 2007b)

**Simulation-Based Medical Education (SBME):** Techniques that attempt to replicate a clinical situation in order to teach clinical or non-clinical skills to members of the medical profession.

**Standardized patient:** *“A well person trained to simulate a patient’s illness in a standardized way”* (Barrows, 1993)

**Thematic analysis:** A widely used, flexible research method that can provide rich and detailed, yet complex account of qualitative data (Braun and Clarke, 2006)

**Virtual patients (VPs):** A type of simulation used in medical education, which utilizes computerized representations of clinical cases (Bradley, 2006, Maran and Glavin, 2003)

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## **AUTHOR'S DECLARATION**

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I declare that the research contained in this thesis, unless otherwise formally indicated within the text, is the original work of the author. The thesis has not been previously submitted to this or any other university for a degree, and does not incorporate any material already submitted for a degree.

Annamaria Witheridge

25.10.2018

### 1.1 INTRODUCTION

The first chapter introduces the context and the key concepts of the present study. As the topic of the project stems from and has implications for medical education, it is important to first explore the current practice of **medical education in the UK** and the factors influencing it. This chapter starts with a brief introduction to the societal and political changes that have influenced the healthcare system in recent years. It then proceeds to describe the key curricular changes in medical education that have taken place as a result of those societal and political influences. It is explained how the 20<sup>th</sup> century gave rise to Simulation-Based Medical Education (SBME), competency based assessments, and the Objective Structured Clinical Examinations (OSCEs). After a brief discussion of these topics, the chapter moves onto outlining the general structure of medical education in the UK and the major transitions along the continuum of medical training, specifically focusing on the graduation transition and the challenges senior medical students face when approaching this transition.

The second part of this chapter focuses on the key cognitive concept of the present study: **diagnostic reasoning**. First, a definition for diagnostic reasoning is provided and the necessity of sound diagnostic reading skills for safe clinical practice is explained. Next, the main cognitive models of diagnostic reasoning will be introduced, portraying the current understanding of diagnostic reasoning according to two main paradigms: the information processing paradigm and the knowledge structure paradigm. This is followed by a comprehensive overview of research findings related to expertise development in diagnostic reasoning. These findings reveal some of key differences in the how individuals with different levels of diagnostic expertise tend to approach diagnostic problems. The research findings also highlight that there is much controversy in this field of research. Recent theories of diagnostic reasoning suggest that *context* may be a key factor to account for some of the heterogeneity in previous studies. Therefore, the role of contextual factors and how those may influence diagnostic reasoning are discussed. In line with these theories, the present study focuses on a single speciality of medicine, *primary care*. The key characteristics of the primary care setting are described and research findings related to diagnostic reasoning in primary care are presented. Lastly, the current position of diagnostic reasoning in the medical curriculum on a national and local level is explored.

## 1.2 THE STATE OF MEDICAL EDUCATION IN THE UK

### 1.2.1 Societal and political changes that influenced the NHS

The ever-changing needs of society have a significant impact on the healthcare system of a country, and the changes in the structure of the healthcare system inherently bring about changes in the educational needs of healthcare professionals. Those responsible for designing the medical curricula need to balance political recommendations, societal needs, limited resources, and pressure from an increasingly autonomous society while designing a coherent medical curriculum that produces competent healthcare practitioners. **In order to understand the present state of medical education in the United Kingdom, it is essential to comprehend the major social and political changes of the previous decades** that have influenced the healthcare system and medical education in the United Kingdom.

In the 1980s and 1990s, society in the UK was going through significant changes. Social theorist, Anthony Giddens described this era as characterized by leaving behind the societal values of the previous decades, such as traditional family structure, gender roles and closeness to the church in favour of more liberal, modern values (Ham, 2009). The transformation of the value system brought about the mounting recognition that adverse events were not so much a matter of fate or fortune, but instead frequently caused by human errors (Ham, 2009). The previously existing complete, unquestioning trust in professionals has been challenged by the rising awareness of the limitations of human expertise, and the **recognition of risks associated with professional practice (Ham, 2009)**. According to Beck (1992), the increased risk awareness of the society in turn led to a preoccupation with attempting to control these risks (Beck, 1992). Risk assessment and risk management in professional practice became more important than ever. To achieve this, people demanded more transparency, auditing, and accountability in professional practice (Ham, 2009, Trinder and Reynolds, 2001). Michael Power (1997) described it as the emergence of the ‘audit society’ to describe this shift in societal values (Power, 1997).

Western society was also experiencing a shift towards growing consumerism and preference for value-for-money services (Ham, 2009). These values were spreading across all aspects of professional practice and had a strong influence on the healthcare field. **Cost-effectiveness, efficiency and quality** of service became the cornerstones of the emerging consumer society (Trinder and Reynolds, 2001). Individuals were

becoming more autonomous with a rising sense of empowerment. The rise in risk-awareness, consumerism, focus on efficiency and cost-effectiveness, together with the increase in scientific knowledge led to the emergence of evidence-based practice in the 1990s (Trinder and Reynolds, 2001, Ham, 2009). It became important in healthcare to utilize cost-effective treatments and interventions with proven efficacy.

The emergence of these new societal values brought new challenges for the healthcare system in the UK. The changing societal values meant that major reorganizations of the healthcare system were required in order to adapt to the new value system. The 1980s and 90s were also characterized by tightened economic policies in the healthcare field, which further contributed to the growing emphasis on efficiency and productivity (Ham, 2009). The Conservative Government elected in 1979 decided to transform the National Health System (NHS) into a more economically efficient, business like system. The Thatcher government's policies were focusing on increasing the efficiency of the NHS while keeping its existing budget. The Government introduced initiatives to encourage cost improvements, savings, and income generation by the healthcare authorities (Ham, 2009). Of all the policies from this era, one of the most influential was the **Griffiths report** in 1983. Roy Griffith, the author of this report, recommended the appointment of general managers in hospitals providing the necessary leadership and supervision for continued development and cost improvement (Griffiths, 1983). These recommendations and initiatives on cost cutting were based on lessons learnt from the private and business sectors, and were welcomed by the Secretary of State (Ham, 2009). However, the implementation of the changes has received mixed reviews. Despite initial successes in reducing the costs and spending by health authorities, by the late 1980s, there was a widening gap between the government funding for the NHS and the money needed to meet the healthcare needs of the society (Ham, 2009).

The funding crisis was also partly attributable to the changing healthcare needs of the British society during this period. With advancements in medical practice, life expectancy was on the increase, more people living longer than ever before. This meant that the **population was expanding and aging at a rate that meant that the healthcare system was not able to cope**. Longer life also meant higher prevalence of chronic, long-term health problems, comorbidities, and polypharmacology. The healthcare system was struggling to balance the growing needs of society and the shrinking budget of the NHS (Ham, 2009).

Another important innovation of this era was the incentive move towards a primary-care led NHS. The government was motivated to reduce the use of hospital services and shift much of the work to the primary care services (Ham, 2009). With the increasingly important role in the NHS, primary care became a central part of the healthcare system, providing first point of contact for patients, acting as gatekeepers for specialist services, as well as a providing of patient-centred, holistic care for every member of the society. Demand for primary care services has been rapidly increasing over the past decades. The Department of Health in England recommends that **in order to meet these growing demands, 50% of all medical students should choose general practice as their career path following qualification** (Department of Health, 2013). However, currently only 19% of medical students plan to work as general practitioners (Harding et al., 2015). This trend is anticipated to lead to serious shortages in the already overstretched general practice workforce (Goodwin et al., 2011).

To sum up, the past decades have seen a significant change in societal values intertwined with political and economic changes that have had a major influence on the structure of the NHS, and on the role and public perception of healthcare practitioners. Naturally, these changes have consequences for medical training. The next section describes the recommendations and changes that have taken place in medical education.

### **1.2.2 Changes in the medical curriculum**

The medical curricula in the UK have seen some fundamental changes over the past three decades. The societal changes of growing risk awareness led to an increasing demand for accountability and transparency towards the medical profession and medical training. In 1993, the General Medical Council<sup>1</sup>(GMC) published their influential report *Tomorrow's Doctors: Recommendations on Undergraduate Medical Education* (General Medical Council, 1993). In this report, the GMC has recognized the need to standardize the medical curriculum nationwide in order to ensure that the same expectations of medical skills and knowledge apply to students graduating from any UK medical school. As a result, the **introduction of a 'core curriculum'** followed, which *involved moving away from "the memorising and reproduction of factual data" and shifting the focus onto "critical study of principles and the development of independent thought"* (GMC, 1993).

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<sup>1</sup> The General Medical Council (GMC) is a statutory body established in 1951 to ensure and promote safe healthcare practices in the UK (Finch, 1958).

The *Tomorrow's Doctors* report has also prompted a **shift towards integrated curriculum** in medical education. In the traditional medical curriculum, there has been a clear divide between the first two pre-clinical years, and the following three clinical years. However, following *Tomorrow's Doctors*, the traditional style curriculum has been replaced in the many medical schools by an integrated curriculum. The integrated curriculum encourages a system-based approach and early patient contact.

There is emerging evidence showing the benefits of an integrated curriculum (Diemers et al., 2011, Watmough et al., 2006, Cave et al., 2007). Pre-clinical patient contact was found to promote the development of coherent knowledge networks in medical students (Diemers et al., 2011). Researchers have also found that early patient contact has beneficial effects on the acquisition and retention of knowledge, motivation for learning, and understanding the effect of a disease on the lives of the patients (Diemers et al., 2008). Other studies have found that students from those medical school that use integrated curriculum feel better prepared for the graduation transition than students from medical schools with traditional curriculum (Wijnen-Meijer et al., 2010). In one of these studies, students especially valued clinical experience during the undergraduate years, communication training and clinical skills training (Watmough et al., 2006).

On the other hand, one study showed that having an integrated curriculum meant that students were concerned about whether they had attained a sufficient level of biomedical knowledge. While the participants in the study did not feel that this affected their ability to work as Pre-registration House Officers (equivalent to Foundation Year 1), it may suggest that emphasize in the integrated medical curricula was shifted so much onto focusing on the clinical and communication skills training, that it fails to provide a sound biomedical knowledge base.

A recent publication, the ***'Promoting excellence: standards for medical education and training'* (2015) by the General Medical Council**, highlights further recommendations to transform the medical curriculum in the UK to adapt to societal changes. The *'Promoting excellence'* report sets out the standards and guideline for medical education that have come into effect in January 2016. The report includes the following main recommendations (General Medical Council, 2015):

- 1) Patient safety needs to receive the highest priority in medical training
- 2) The learning environment should be safe for patients, students, and educators.

- 3) Both learners and educators should receive sufficient support
- 4) The quality of education should be continuously improved by measuring performance against set standards
- 5) The medical curricula should be continuously assessed and developed

The recommendation about **patient safety is meant to be at the core of all standards of medical training**. Rising concerns over patient safety in medical training have been receiving more attention over the past decades. Some have argued that patients were being treated as mere commodities for medical training without concern for the safety or privacy of the patient (Lynöe et al., 1998, Hayes, 1994, Kaldjian et al., 1999). Alarming reports were published stating that patient autonomy, the right of patients to decide if they are willing to be treated by trainees, was often overlooked in clinical practice (Rees and Monrouxe, 2011). Moreover, it was found that patients were often not informed when trainees were treating them, and vulnerable patients may not have had the ability to decline being observed or treated by trainees (Ziv et al., 2003, Rees and Monrouxe, 2011). These concerns led to the increasing tightening of ethical guidelines concerning patient safety in medical education, which had a direct influence on the level of patient contact during medical training. This means that previous generations of medical trainees had much more opportunity for direct patient contact during their training years than the medical students today (Illing et al., 2008). This recognition highlighted the **importance of complementing present medical training with suitable alternatives, such as simulated patients**, which offer opportunities for clinical practice in a safe environment. The GMC recognizes and explicitly states this in their report that medical training should include both real and simulated setting for learning.

The *'Promoting excellence'* report also recommends that medical schools should provide medical students with opportunities for early patient contact that should increase in duration and responsibility as they are progressing through their training program. The GMC recognizes in their report that medical training should include both real and simulated setting for learning that increases in complexity as students are progressing through their training. Furthermore, it is recommended that **students should have sufficient experiential learning opportunities in various clinical settings with a wide range of patient groups**, where they can attempt to integrate theory and practice. Finally, they need to develop a range of clinical, medical and

practical skills and generic professional qualities through technology-enhanced learning before they test their skills in a real clinical environment.

Postgraduate medical training has also seen significant changes over the past decades. At the beginning of the 20th century, the scope of biomedical knowledge rapidly increased and societal demand for specialist care led to an increasing specialization within postgraduate medicine (Teunissen and Westerman, 2011b). In 2005, the **Foundation Program was implemented** replacing the position of preregistration house officer and senior house officer. Previously, junior doctors spent three to five years as a senior house officer before having to decide on their speciality area., while the Foundation Program has provided a fast tracking towards the specialization training (Bannon, 2006).

An influential report, the *'Shape of Training'* (2013), led by Professor David Greenaway and sponsored by the GMC, the Academy of Medical Royal Services, Health Education England and Medical Schools Council, among others, focuses on **recommendations for the postgraduate curriculum** in the UK. They encourage a shift towards a more generalist approach in postgraduate training (Greenaway, 2013). According to the author, this shift in emphasis to 'generalist' training, could transform medicine important ways. Firstly, they point out that a more broadly trained medical workforce would be more capable of taking on various roles and responsibilities, and would be more capable in rural and isolated areas as well as in emergency and acute care. Secondly, the authors highlight that a more generalist training would mean more transferable skills and competencies, which in turn could enable medical professionals to move across specialities and programmes during their career. Thereby, **broader speciality training would benefit doctors, employers and the community alike**. These recommendations have significant implications for studies looking at medical education – the present study will investigate general, broad diagnostic skills as opposed to focusing on a speciality.

The *'Shape of Training'* review also recommended moving the point of full registration with the General Medical Council to the time of the graduation, if students' fitness to practice can be demonstrated by the end of medical school (Greenaway, 2013). Were this to be implemented, it would be vital that assessment of the essential skills of medical graduates is accurate, and that appropriate supervision is in place in line with their level of competency. The authors **recommend moving away from 'ticking**

**boxes' for assessment and move towards a more apprentice type training** with evaluation that focuses on working safely (Greenaway, 2013). Finally, they state that it is important to demonstrate clarity in the training. Patients have the right to know what competencies doctors have at different stages of their training. It is also important to specify the roles and responsibilities of doctors and healthcare professionals.

Finally, the changing needs of society are not the only factors that have a significant influence on medical training; it is also the generation of students training to become doctors. Strauss and Howe (2000) suggest that people from the same generational period, lasting about 20 years, will share certain characteristics due to experiencing the same societal events during their formative years (Strauss and Howe, 2000). The generational changes in medical school students from Generation X (born 1964-80) to the Millennials, also referred to as Generation Me or Generation Y (born 1981-1999) (Twenge, 2009, Borges et al., 2010). **The new generation has different needs and expectation as the one before, which medical educators need to take into account.** In Generation Y, there is an increasing role for information technology, evidence based training, need for more clinical experience. The new generation would benefit from a more structured but interactive approach with frequent feedback (Twenge, 2009). Assessment should move away from the reductionist, box-ticking approach towards a competency based approach which incorporates communication, clinical investigation and clinical reasoning skills (Jones, 2009).

All in all, there has been many changes in the medical curriculum over the past decades, aimed at adapting medical training to the changing needs of society. The introduction of the 'core curriculum', the emergence of the integrated curriculum, and the gradual tightening of ethical standards over patient contact during medical training all contributed to the reshaping of the basic structure of undergraduate medical education. In postgraduate medical training, during the early 20<sup>th</sup> century, there has been a shift towards specialization, while with the Greenway report there seems to be shift in the opposite direction: towards generalist training and general skills.

### **1.2.3 Simulated practice in medical education**

The second half of the 20<sup>th</sup> century has given rise to **Simulation-Based Medical Education (SBME)**. Those societal and political factors that led to changes in the standards of medical education and the medical curricula were also the driving forces

for the introduction of simulation-based training. Changing societal expectations, increased patient autonomy, increased focus on risk management and accountability all played an important part (Bradley, 2006). It has been increasingly recognized that medical students need to be better prepared before they could ‘practice’ on real patients. Patients were no longer unquestioning of the medical profession (Santen et al., 2004, Santen et al., 2005). Studies were highlighting issues of patient privacy, dignity, and safety relating to medical training (Kalaniti and Campbell, 2015, Chapman et al., 2014, Monrouxe et al., 2015). Professional regulations also meant that medical students have less learning opportunities in clinical environment than their predecessors, due to less availability of clinical tutors and suitable patients, working time restrictions, shorter time in training, and reduced hours at bedside teaching (Ker and Bradley, 2010).

Taking into account the above mentioned issues, Ziv et al. (2003) argued that there is an **ethical imperative for developing and implementing Simulation-Based Medical Education** (Ziv et al., 2003). The Consortium of American College of Surgeons-Accredited Education Institutes also calls for a longitudinal, simulation-based curriculum spreading across the continuum of medical education in order to improve the preparedness of medical students for their post-graduation years (Gardner et al., 2015). It appears that the question regarding SBME is not whether or not to implement it, but how to integrate it into the medical curriculum (McGaghie et al., 2010).

Simulation can be implemented as a continuing systematic training for professionals at all levels. SBME has great potential and the range of simulation techniques is rapidly growing. However, different simulation techniques may be better suited for different levels of expertise and educational targets (Gesundheit et al., 2009, Kalyuga et al., 2003, Norman, 2005a), and therefore **simulation should be tailored to the learners and specific learning goals** in order to maximize educational gains. Further research is necessary to explore how the types of simulation, nature of the clinical skills, and the level of expertise of the learner can be matched in order to reach optimal results in medical education.

SBME offers medical trainees an opportunity for **practice in a safe environment**. It incorporates feedback and allows trainees to learn from their mistakes. There is a wide range of different simulation techniques used in medical education. Some of the most commonly used techniques involve part-task trainers, virtual patients (VPs), manikins

(e.g. METI or Laerdal's SimMan), standardized patients (SPs), and simulated environments. The key characteristics, strength and weaknesses of each of these techniques are summarized in Table 1.

**Table 1: Approaches to simulation: advantages and weaknesses (Bradley, 2006, Maran and Glavin, 2003)**

<b>Type of simulation</b>	<b>Description</b>	<b>Strength</b>	<b>Weaknesses</b>
<b>Part-task trainer</b>	A model representing part of the human body	Low cost Enables physical examinations	No human factor Low fidelity
<b>Virtual patient (VP)</b>	Computerized representations of clinical cases	Allows independent learning Interactive Allows for feedback Can be tailored Consistent Low cost Can demonstrate physical abnormalities	No human factor No physical body Low fidelity
<b>Standardized patient (SP)</b>	A healthy individual trained to act out a specific patient role in a standardized way	High fidelity Human factor – Non-verbal cues and communication is incorporated	Facilitator needs to be present
<b>Integrated simulator (METI, SimMan)</b>	Whole body manikins combined with sophisticated computer controls	High fidelity Enables physical examinations	No opportunity to communicate with the 'patient' High cost
<b>Simulated environment</b>	Recreating the ward environment, using SPs or manikins for patients	High fidelity Better transfer	Cognitive overload

Although based on Table 1, the use of virtual patients appears to have the greatest number of advantages, it may not necessarily be the most appropriate technique for all levels of expertise. Of all the simulation techniques available, SPs are the only simulation type, which can introduce the human factors into simulation training. Henry (2010) highlights the central role of direct, face-to-face interaction with patients while conducting clinical reasoning. He points out, that written records cannot convey the same kind of richness of information that arises from direct contact (Henry, 2010). Nonverbal communication can convey a great deal of information. Being a healthcare professional involves interacting and understanding patients, not merely acting as data gathering machines. His account highlights the usefulness of using standardized patients over the use of virtual patient when training consultation skills.

Studies that empirically compare the **strength and weaknesses of different simulation techniques** for diagnostic reasoning training are scarce. One study compared the costs and effectiveness of a Web-based program versus SPs in teaching diagnostics skills (Turner et al., 2006). They have found that the learning outcomes of these two techniques for second-year medical students were comparable, and as were the start-up costs for the two interventions. The on-going cost of the SPs was slightly higher than the costs of the web-based intervention. Their surveys also showed that students preferred the SP method over the VP method. Taking into consideration the necessity of high internal motivation for expertise development (Ericsson et al., 1993), students' preferences in the form of educational intervention can influence the outcome of the intervention. Therefore, students' perspectives and preferences should not be ignored when planning their curriculum. If medical students prefer SPs over VPs, the use of SPs is more likely to increase their intrinsic motivation, and thereby facilitating expertise development. Another study from New Zealand reported that using an SP clinic made students motivated and enthusiastic about their future roles as doctors (Williamson et al., 2013), which is a very important outcome that is highly desirable from educational interventions. Therefore, even if the cost of SP training slightly exceeds the cost of VP training, but SP training leads to more highly motivated students, the costs can be justified.

In another study, the acceptance of a web-based VP training was used to target clinical reasoning skills (Gesundheit et al., 2009). They had two participant groups, second-year and fourth-year medical students. They found that the acceptance of the program was higher for pre-clinical students. This may suggest that VPs are better suited for students who have not yet had much clinical exposure to real patients. Perhaps students with more experience, a higher-fidelity simulation, such as using standardized patients, would be better suited. The **expertise reversal theory** highlights the fact that certain instructional techniques that are highly effective for novices may be much less effective for more advanced learners (Kalyuga et al., 2003)

Another important factor when designing simulation-based training is to consider the cognitive load of the tasks (van Merriënboer and Sweller, 2010, Paas et al., 2003, Plass, 2010). **Cognitive load theory** (Sweller, 1988, van Merriënboer and Sweller, 2010) claims that due to the limited capacity of human working memory, it is possible to overload the working memory, which in turn will impede learning. Therefore, when designing a learning task or learning opportunity, it is essential that the instructional

design is such that does not overload the working memory (Qiao et al., 2014). The cognitive load theory proposes that there are three types of cognitive loads that are additive: intrinsic, extraneous, and germane load. *Intrinsic load* refers to the inherent difficulty of the task at hand in relation to the prior knowledge and experience of the learner. The *extraneous load*, on the other hand, refers to the load created by the way the task is presented and by interaction with the task (such as interaction with the educator). Finally, the *germane load* is the cognitive resources dedicated to learning the new task. These various types of cognitive loads can have an additive impact and lead to cognitive overload when their sum exceeds the working memory capacity of the individual. According to the theory, an ideal task design would aim to minimize extraneous load, maximize germane load, and avoid cognitive overload (van Merriënboer and Sweller, 2010, Young et al., 2014).

A recent study has also looked at the relationship between emotions and cognitive load (Fraser et al., 2012). In the study, they investigated first year medical students conducting simulated training scenarios. They have found that increased anxiety during simulation training is associated with increased cognitive load which suggests that reduced tranquillity leads to an increase in extraneous cognitive load (Fraser et al., 2012). They also found that this increased cognitive load was associated with reduced accuracy in performance (Fraser et al., 2012). While the study was observational in nature and therefore could not establish causation, the authors emphasized the importance of ensuring that simulated training does not induce high levels of anxiety in order to avoid the cognitive overload of learners.

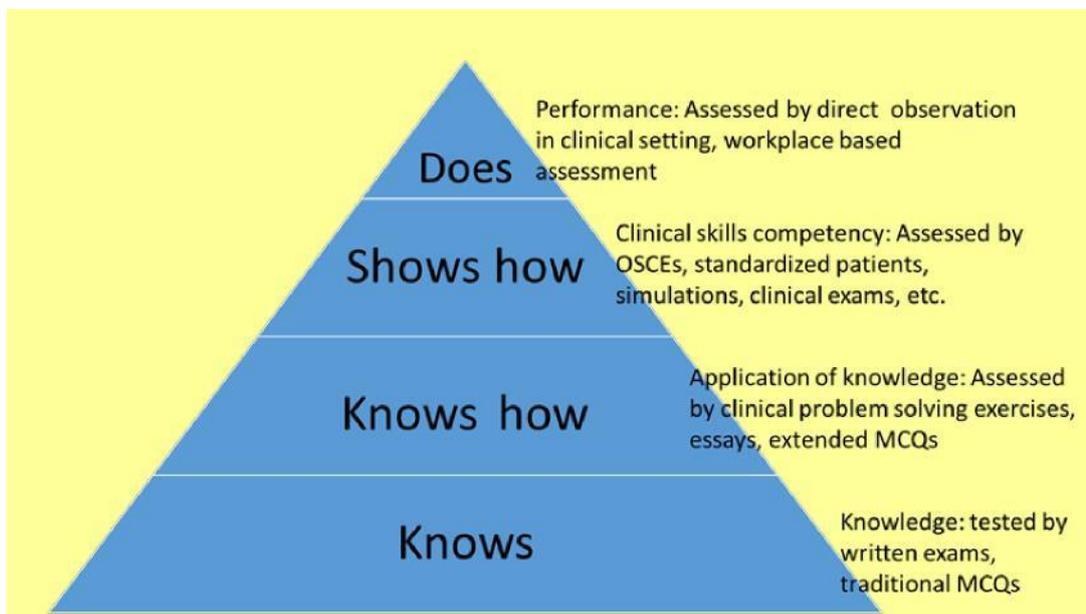
However, when simulation is carefully designed, taken into account important factors such as cognitive load, it can be a very useful educational technique (McGaghie et al., 2011, Qiao et al., 2014). Simulation based techniques have been proven to be beneficial in improving various clinical skills, confidence, and subjective perception of preparedness for practice (Schwind et al., 2011, McGregor et al., 2012, Williamson et al., 2013, AlRawahi and AlShidhani, 2002, McGaghie et al., 2010).

#### **1.2.4 Competency based assessment and Objective Structured Clinical Examinations**

The 20<sup>th</sup> century has also seen a **change in the nature of assessments used in medical education**. In 1990, George Miller outlined a new model for clinical assessment (Miller, 1990). In an era where the medical curriculum was largely dominated by

theoretical knowledge based assessments, he called attention to the importance of clinical performance. Miller argued that the traditional assessment of medical students relied too much on testing their knowledge, and not enough on assessing how medical students would behave in the presence of an actual patient (Miller, 1990). His model, known as the ‘*Miller’s pyramid*’, marked an important move away from the traditional, knowledge based assessments towards examinations based on clinical competence. Miller’s pyramid model divides clinical competence into four, hierarchical levels (See Figure 1). The lower levels account for the cognitive components of competence, which include knowledge and the application of knowledge. The top two levels of the pyramid account for the behavioural components of clinical competence, which involves the practical demonstration of learning and clinical performance. By positioning observable behaviour at the top of the hierarchy, the model indicates a preference towards the behaviourist tradition, as opposed to cognitive perspectives. Miller’s approach suggested that simulated practice could be a good approximation of how students would behave in the real clinical world, and thereby argued for the introduction of performance based assessments.

*Figure 1: Miller’s pyramid of clinical competency assessment (Miller, 1990)*



In the second half of the 20<sup>th</sup> century, the new ‘**performance-as-competence**’ orientation led to an increased use of a new form of assessment in medical training, known as **Objective Structured Clinical Examinations (OSCEs)**. OSCEs were first conceptualized in 1975 by a Scottish professor of medicine called Ronald Harden at the University of Dundee (Harden et al., 1975). Harden and Gleeson (1979) first described this new form of assessment as the following:

*”a timed examination in which medical students interact with a series of simulated patients in stations that may involve history-taking, physical examination, counselling or patient management” (Harden and Gleeson, 1979)*

These examinations were designed to test the clinical competence of trainees in a novel way, through the observation of participants across a series of stations, evaluated based on standardized checklists, providing a level of objectivity (Harden et al., 1975) OSCEs were rapidly growing in popularity, not only in medicine, but in various other health professions as well, such as nursing, midwifery, dentistry, pharmacy, and physiotherapy (Nicol and Freeth, 1998, Mitchell et al., 2014, Nayer, 1995, Corbo et al., 2006, Manogue and Brown, 1998). By the 1990s, OSCEs were widely adopted by medical school in the United Kingdom, Holland, United States and Canada (Hodges, 2007). Today, OSCEs are considered the **gold standard for assessment of competency in medical education** (Risse et al., 2017).

While standardized patient OSCEs are widely used and popular, there has been **some controversy and concern over their predictive power**. Barman (2005) reviewed the psychometric properties of OSCEs and found that OSCEs alone may not be sufficient for the comprehensive assessment of clinical competence as they cannot assess all assets of clinical competence (Barman, 2005). Norman (2005) went as far as stating that standardized patient OSCEs are no better at predicting real clinical performance than multiple choice exercises (Norman, 2005a). He has identified several studies which have found low correlation between performance during standardized assessment settings, such as OSCEs, and real clinical performance (Ramsey et al., 1989, Davis et al., 1990, Ram et al., 1999, Norcini et al., 2002). Norman also calls attention to a comprehensive systematic review by Issenberg et al. (2005), which reports on the modest added value of high fidelity simulated practice in medical education (Issenberg et al., 2005). However, importantly, Norman did not argue that high fidelity simulations have no use at all, instead he claimed that the same simulation may not be appropriate for certain skills or certain levels of expertise (Norman, 2005a). Norman’s editorial serves as a reminder that the use of simulation based practice needs to be continuously evaluated in order to decide their suitability for training or assessing various clinical skills. The literature review presented in this paper (See Chapter 2) demonstrates that there is a **scarcity of studies looking at diagnostic reasoning during simulated scenarios** among senior medical students.

### 1.2.5 The medical education continuum

Medical training in the United Kingdom starts with the undergraduate program.

Generally, the length of undergraduate training is five years. However, graduate entry programs and the possibility of intercalation means that programs can range from four to six years. Once a student has successfully obtained a degree in medicine, they will enter a two-year Foundation Program, and will be provisionally registered with the General Medical Council (GMC). After completing the first foundation year, full registration with the GMC is awarded. Once the second year of the Foundation program is successfully completed, doctors move on to become speciality registrars by undertaking further training in their chosen speciality. Speciality training in general practice lasts for three years, while other speciality trainings can last up to 5-8 years. The complete training period beginning with undergraduate education and culminating in the completion of the speciality training is referred to as the ‘medical education continuum’ (Teunissen and Westerman, 2011b).

Throughout this continuum, there are **three important transition points**. The *first transition* one occurs after the first three years of pre-clinical undergraduate education to the clinical rotations. The origins of this transition can be traced back to the Flexner report, published in 1910, which transformed the nature of medical education in the USA and Canada (Flexner, 1910). The report emphasized the importance of solid biomedical knowledge as a foundation for medical training. He recommended training in analytical reasoning and scientific method of thinking during the early years of medical education. Flexner believed that when students master the scientific thinking and problem solving, they will be able to deal with the uncertainties of clinical practice. In Flexner’s recommendations, this scientific oriented, ‘pre-clinical’ phase was followed by a clinical training among patients guided by expert clinicians. He emphasised that once the foundations of biomedical knowledge are laid, students can move onto the next phase which would be characterized by ‘learning by doing’ (Ludmerer, 2010). However, this transition may be less pronounced in medical schools, which have adopted the integrated curriculum approach, providing opportunity for early patient contact.

The *second transition* in the continuum of medical education takes place after the completion of the undergraduate training program. When students graduate from medical school, they take on the role of junior doctors, and move onto their 2-year-long vocational training. **The transition between medical school and Foundation training is an especially important one and many UK graduates find it particularly difficult to**

**adjust to** (Teunissen and Westerman, 2011b, Teunissen and Westerman, 2011a). Their new role as junior doctors is accompanied by a change in role, responsibilities, and setting. From having no responsibility as medical students, they suddenly gain authority in the decision-making process and case management as healthcare providers. While previous generations of medical students have had more opportunities to take responsibility as senior medical students, thereby preparing for the pressure of being a junior doctor, the tightened ethical guidelines on patient contact and changes in the medical curriculum means that medical students nowadays cannot do the same. This may mean that they progress from having no responsibility to high responsibility in a very short period of time. It has been reported that junior doctors experience high levels of anxiety and stress relating to their new responsibilities (Schwind et al., 2011), some statistics showing that the burnout rate among junior doctors can reach alarmingly high levels (Bogg et al., 2001). When presented with such a challenging task, medical trainees need adaptive coping strategies to deal with these new demands. One way to introduce responsibility gradually is through the systematic use of simulated exercises and supervised practice with feedback. Given appropriate training and preparation, these challenging transitions can become “opportunities for accelerated learning” (Teunissen and Westerman, 2011a, Teunissen and Westerman, 2011b, Abdulghani et al., 2011, Helmers et al., 1997, Prince et al., 2005).

In order to optimize preparation for the graduation transition, it is important to understand what aspects of the medical training are not sufficiently preparing medical students for clinical practice. A 2014 report by the GMC ‘*How prepared are UK medical graduates for practice?*’ examines this issue (Monrouxe et al., 2014). In this report, they summarize the findings from a literature review (2009-2013), interviews with relevant stakeholders and the findings from audio-diaries with Foundation Year 1 doctors. They concluded that **junior doctors** felt reasonably **well prepared for history taking and full physical examinations**. On the other hand, they felt **unprepared for the increased responsibility** that came with becoming a junior doctor. They also felt unprepared for the workload, multitasking, asking for help, understanding the patient in a holistic manner, understanding the financial aspects of healthcare, dealing with medical emergencies, time management, safe prescribing and diagnosing. There was mixed evidence for preparedness in communication skills. It has been suggested that these difficulties around the graduation transition and unpreparedness for clinical

practice may arise due to the **mismatch between the undergraduate training outcomes and the actual demands of real life clinical practice** (Illing et al., 2008).

Finally, the *third and final transition* along the continuum of medical education occurs at the end of the specialty training when trainee doctors become independent practitioners. The majority of studies about this transition are based on quantitative self-report measures. Their results show that trainee doctors feel generally well prepared for their role as independent practitioners with regards to their clinical skills (Beckett et al., 2006). However, they feel less prepared with regards to non-clinical tasks such as management, teaching, and finances (Higgins et al., 2005). This suggests that postgraduate training should focus on complementing their education with training that specifically targets these above-mentioned skills.

To sum up, the three major transitions in medical education can have a strong influence on the medical trainees. When prepared properly, these transitions have the potential to be formative experiences that advance learning and provide a opportunities for rapid personal development (Teunissen and Westerman, 2011b). The transitions can serve as an opportunity for learning and developing appropriate coping techniques to adjust with the new role. The ease of transition reflects how well prepared they are by the training preceding the transition, and thereby providing a mirror for the education system (Weller, 2014). It is important to identify factors that promote and factors that impede learning during this period in order to make the most of the transition and optimise learning. The present study focused on senior medical students approaching the graduation transition and Foundation trainees to explore how they approach diagnostic consultations in primary care.

### 1.3 DIAGNOSTIC REASONING

The present study focuses on the cognitive skill of **diagnostic reasoning**, which is one of the most important competencies of all clinicians. In the healthcare literature, the phrases '*diagnostic reasoning*', '*clinical reasoning*', '*diagnostic decision-making*', '*clinical judgement*', '*diagnostic problem solving*' have been used synonymously and interchangeably over the years. In the present study, the term *diagnostic reasoning* refers to the thinking process of a clinician in collecting information about a patient, processing that information, coming to an understanding of the patient's problem, and coming up with a suitable management plan. This ability involves ways of reasoning through the patient's problem and making informed decisions based on the available information. It is an essential, dynamic, and highly complex skill, which lies in the heart of safe medical practice.

Without sound diagnostic reasoning skills, patient safety is jeopardized. Over the past decade, it has been increasingly recognized that **diagnostic errors** occur frequently and lead to significant costs for healthcare organizations (Thammasitboon and Singhal, 2013, Graber, 2005, Graber et al., 2005). While medical errors can be attributed to a variety of causes, ranging from communication mistakes, through inadequate technical skills, to medication errors, it has been found that one of the leading causes of medical errors is a fault in the diagnostic process (Nendaz and Perrier, 2012). It has been found that diagnostic errors account for the largest percentage of medical errors and lead to the most serious patient harm (Tehrani et al., 2013, Graber, 2013). It has also been shown that the majority of diagnostic errors can be linked to cognitive errors (van den Berge and Mamede, 2013, Thammasitboon and Cutrer, 2013, Nendaz and Perrier, 2012, Graber et al., 2005, Graber, 2005). One particular US study by Graber et al., (2005) has reported that up to 74 percent of medical errors in internal medicine can be linked to failures in the clinician's diagnostic reasoning process (Graber et al., 2005). These statistics are worrying and demonstrate the importance of continued research on the diagnostic reasoning process.

In 2015, the Institute of Medicine launched a report in which they acknowledged that there is an urgent need for research on the diagnostic process in healthcare (National Academies of Sciences, 2015). In the report, they called for better education and training in all aspects of diagnostic skills, involving reasoning.

### 1.3.1 Cognitive models of diagnostic reasoning

The study of thought processes is generally associated with the field of cognitive psychology. Cognitive psychology studies both basic cognitive processes such as attention, perception, and memory, and complex mental processes such as reasoning, decision-making, and expertise development. Over the past 40 years, there has been much research aimed at understanding the process of diagnostic reasoning from a cognitive perspective (Norman, 2005b, Norman et al., 2007). Over this time, two leading theories emerged: the dual-process theory and the knowledge encapsulation theory (Schmidt and Rikers, 2007). The *dual-process theory* emerged from the information-processing paradigm and it focuses on the analytic and non-analytic reasoning processes used by physicians. The *knowledge encapsulation theory*, on the other hand, emerged from a line of research focusing on the normative development of cognitive structures during medical training. Over the years, these models have inspired several empirical studies. However, empirical evidence for these models has been inconclusive, which suggests that more research is needed in this field.

#### 1.3.1.1 *The information processing paradigm*

In the 1970s, cognitive scientists started to conduct observational studies, whereby they asked expert clinicians to verbalize their thinking process while solving and managing a clinical case in order to gain insight into their reasoning process (Norman, 2005b, Elstein et al., 1981, Elstein, 1978). It was hoped that if researchers could somehow make the tacit diagnostic reasoning processes of experts ‘visible’, they could use that for teaching novices how to solve clinical cases more effectively. From these initial studies, the finding emerged that experts tend to use a so called **hypothetico-deductive reasoning** style when solving diagnostic problems (Style, 1979).

In hypothetico-deductive reasoning, the clinician generates hypotheses early on during the consultation based on the patient’s complaints and symptoms, and then moves on to gathering further information from the patient in order to test those early hypotheses. If the information collected from the patient is consistent with the hypothesis, the clinician accepts the diagnosis and moves onto management. If the initial hypothesis is refuted by incongruent information, new hypotheses are generated and tested. This cycle continues until the physician reaches the final diagnosis. Hypothetico-deductive reasoning essentially mirrors the basic model of scientific inquiry. However, the idea that this type of reasoning was the distinguishing feature of expert thinking was questioned when

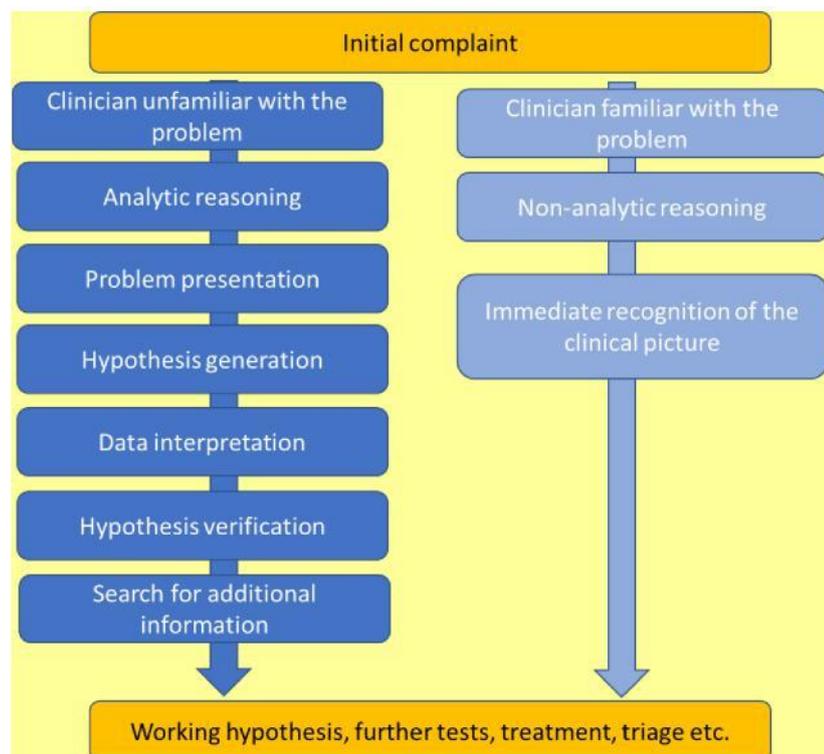
researchers found that novices tend to use a very similar hypothesis testing processes (Neufeld et al., 1981a, Elstein, 1978). Hypothetico-deductive reasoning was found to be a general way of reasoning through a case used by clinicians at all levels of expertise (Neufeld et al., 1981a, Barrows et al., 1982). It was found that upon patient encounter, both novices and experts seem to generate similar number of hypotheses under a short period of time (Neufeld et al., 1981a).

Therefore, in the 1990s, researchers concluded that although hypothetico-deductive reasoning is an important part of the diagnostic reasoning process, it is not the single process underlying expert diagnostic reasoning. This prompted researchers to turn their interest towards **the role of intuition and experience**. They found that experts use a range of different reasoning processes in a flexible manner that enables them to solve clinical problems more effectively than novices (Epstein, 1994). One of the most influential theoretical models of diagnostic reasoning that has emerged through this line of research in the mid-1990s was **the dual-process theory** (Epstein, 1994, Hammond, 1996). Subsequently, this theory became one of the corner stones of medical reasoning literature.

The dual-process theory proposes the presence of two separate but interacting cognitive processes that guide diagnostic reasoning: ***non-analytical reasoning (NAR) and analytical reasoning (AR)*** (See Figure 2). The role of these two cognitive strategies in diagnostic reasoning has been subject to considerable research over the past years (Thierry et al., 2011, Croskerry, 2009b, Norman, 2009, Norman et al., 2007, Norman and Eva, 2010, Eva, 2005). It has been proposed that NAR is unconscious, rapid, context-dependent, and relies heavily on similarities to past experiences (Evans, 2008). It is assumed that when healthcare professionals encounter a patient with familiar symptom presentation, NAR acts first, generating a fast, intuitive diagnostic response without much cognitive effort (Thammasitboon and Cutrer, 2013). However, when the symptom presentation is unfamiliar or complex, AR takes over to generate a diagnosis. AR is a conscious, logical, controlled process that is time consuming, and requires high cognitive effort (Evans, 2008). It has been claimed that expert practitioners rely more on the use of their NAR, and only use AR when they encounter complex, challenging cases. This is due to the fact that over their years of practice, they have accumulated a vast body of mental representations of various illnesses, which can guide their diagnostic reasoning without having to engage in effortful, analytic reasoning. On the

other hand, novices, due to their lack of previously encountered examples, rely heavily on their analytic reasoning strategy when making a diagnosis.

**Figure 2:** *Dual-process theory of diagnostic reasoning (Nendaz and Perrier, 2012)*



Norman et al. (2007) argues that experts generate more accurate diagnostic hypothesis due to the availability of previous exemplars (Norman et al., 2007). Eva (2005) has also argued that diagnostic competence largely depends on the possession of rich mental representations of diseases, which can be acquired through repeated patient encounter (Eva, 2005). . These highlight the importance of experience and non-analytical reasoning processes in diagnostic reasoning expertise (Norman et al., 2007).

The dual-process theory has received much support over the years (Evans, 2008, Evans 2010), and multiple versions of the original theory have been proposed (Sloman, 1996, Evans, 2007, Barbey and Sloman, 2007, Kahneman, 2012). Even neuroimaging studies have found support for the involvement of both analytic and non-analytic cognitive processes in expert diagnostic reasoning (Durning et al., 2016, Durning et al., 2015). At the same time, these dual-process accounts of diagnostic reasoning have also been subject to considerable criticism (Osman, 2004, Gigerenzer, 2010, Keren and Schul, 2009, Kruglanski and Gigerenzer, 2011). The major points of criticism comprise (Evans and Stanovich, 2013):

- 1) there are several different accounts of the dual-process model with vague terms and definitions (Keren and Schul, 2009);
- 2) the distinctive characteristics attributed to the two different cognitive systems (AR and NAR) are not consistent and do not always hold together;
- 3) instead of distinctive processing types, there is a continuum of processing style (Kruglanski and Gigerenzer, 2011);
- 4) a dual-process account is just one way to interpret the existing data, single-process account is also possible (Osman, 2004, Keren and Schul, 2009);
- 5) the evidence base for dual-process theory is weak and ambiguous (Kruglanski and Gigerenzer, 2011).

In light of these recent criticisms, it is important to continue research on this area in order to address contradictions and to further refine the model.

#### ***1.3.1.2 The knowledge structure paradigm***

When the early theories of the information processing paradigm failed to explain the superior diagnostic performance of expert clinicians, researchers turned to other paradigms in the hope of better understanding diagnostic expertise. In the 1980s and 1990s, much of the diagnostic reasoning research was focusing on the organization of knowledge as the underlying factor for superior diagnostic ability (Norman, 2005b).

According to cognitive psychologists, information that people acquire about the world is organized into cognitive models. These mental representations of the world are activated whenever people encounter a relevant piece of information. These models provide meaning and structure to our understanding of the world. The knowledge structure models of diagnostic reasoning are based on these premises.

Several studies led researchers to conclude that experts have a more effectively organized knowledge base, which they can recall rapidly when presented with a case. The **knowledge encapsulation theory** (Schmidt and Boshuizen, 1993a) proposes a model of how knowledge organization changes over the years of medical training and how it eventually leads to a knowledge structure that enables expert diagnostic reasoning. The following stages of cognitive development are proposed:

1. *Causal networks* - The theory predicts that novice medical students accumulate a large amount of textbook based knowledge in the first years of their training. This knowledge is organized into a rich causal network of causes and consequences of illnesses in a pathophysiological level. Therefore, when novice students first attempt to diagnose a clinical case, they will focus on isolated signs and symptoms, and refer to them in basic pathological terms. They tend to interpret symptoms separately, which is a very effortful reasoning style. At this stage, they have limited experience with real patients, and their knowledge mainly involves the prototypical cases of illnesses. They do not yet know much about the clinical variability of illnesses.

2. *Encapsulated knowledge* – Once the student starts to have exposure to real patients, they will apply their knowledge to the clinical cases. After seeing a couple of the similar cases, their mind will create mental shortcuts. Their detailed, pathophysiological knowledge starts to compile into a smaller number of higher-level concepts. These structures will involve clinically relevant information and support a more time efficient way of reasoning. They do not need to refer to basic science anymore, and end up with a simplified model of the illness, which contains sufficient information for diagnosis and management.

3. *Illness scripts* – As they start to pay attention to contextual factors and what factors generally make the occurrence of an illness more or less likely (called enabling conditions), they will start forming so called illness scripts. This is a narrative style of thinking, and is achieved through repeated patient encounter.

4. *Instance scripts* – Finally, once a physician has encountered a large number of patients, they will less likely to rely on their illness scripts, and more likely to use instance scripts. The theory proposes that doctors retain in their memory individual patient profiles, which are recalled when a patient with similar symptom presentation is encountered. They associate this process with pattern recognition.

Throughout the years, there have been mixed evidence relating to the knowledge encapsulation theory. There have been studies whose findings support the knowledge encapsulation theory (Young et al., 2016, Coderre et al., 2003). Similarly, to the dual process theory, the knowledge encapsulation theory also received support from neuroimaging studies that have found differential brain activation between experts and novices during diagnostic problem solving (Durning et al., 2016). However, there are

also studies whose findings seem to contradict the fundamental assumptions of the knowledge encapsulation theory (Eva et al., 2002).

The knowledge encapsulation model and the dual-process model both provide useful information about the cognitive foundations of diagnostic reasoning. Both of these models acknowledge the importance of previous clinical experience as one of the cornerstones of diagnostic expertise development. In the dual process theory, previous experience allows experts to develop and rely on non-analytic reasoning strategies, such as pattern recognition, while in the knowledge encapsulation theory, increasing amount of clinical experience leads to a reorganization of knowledge structures, which eventually leads to the formation of illness scripts and instance scripts that experts can utilize during diagnostic consultations. However, **given that the development of these models date back to the 1990s** (Schmidt and Boshuizen, 1993a), **it is important to reexamine whether these models are still relevant today, given the significant changes in the medical curricula.** Heightened ethical regulations relating to patient contact during medical training, reduced hours for bedside teaching, the introduction of an integrated curriculum, and complementing medical training with simulation-based techniques are all important curricular changes that are likely to have an effect on the way medical students acquire diagnostic skills. Therefore, it is important not to solely rely on research data from experts and novices trained through the previous system of medical education, and to re-examine how newly qualified doctors and medical students today use diagnostic strategies in order to optimize their training.

### **1.3.2 Expertise development**

Studies investigating the diagnostic reasoning development of medical trainees and medical experts have provided some mixed results. One early study found that there was no significant difference in the diagnostic reasoning of medical students at various stages of their undergraduate years (Neufeld et al., 1981b). In their study they used stimulated-recall exercises to explore diagnostic reasoning. Participants were tested annually from the same cohort of students starting from pre-clinical years throughout their undergraduate training, up until their first postgraduate year. This early study indicated that diagnostic reasoning competence remains constant during undergraduate training.

On the other hand, another early study using different research approach found opposite results. In their study, Bordage and Marsden (1990) used quantitative measures to explore diagnostic reasoning skills. They found evidence of gradual improvement of diagnostic reasoning across the continuum of medical education (Bordage et al., 1990). Another recent study also found gradual improvement in diagnostic performance during the first three years of undergraduate study (Williams et al., 2011). In this study, the authors also expected to find accelerated improvement during the third year as a result of students being immersed into clinical practice. However, similarly to a previous study (Williams et al., 2008), they did not find larger gains after the first clinical year. This shows that clinical exposure on its own does not necessarily lead to the accelerated development of diagnostic reasoning. This is in line with the findings of another study, which found that the mere amount of clinical exposure on its own is not sufficient to facilitate the learning of medical students (Wimmers et al., 2006). Instead, it is the quality of the supervision during clinical placements, which directly affects the students' clinical competence.

These studies provide evidence for diagnostic reasoning development during undergraduate medical training, however, the developmental trajectory of this skill is not yet fully understood. Theories of expertise development suggest that trainees will progress through various phases of skill development and perform differently on diagnostic tasks based on their level of expertise. According to one influential **learning theory by Dreyfus**, learners progressing through five, distinct stages of expertise development during skill acquisition (Dreyfus, 2004). First, *novices* start by learning the rules in a context-free environment. Then the learners are given the chance to practice their skills in real environments, which provides them with real life examples. At this *advanced beginner* stage, they still tend to think in a mainly detached, analytic way. With increasing experience in real environments, learners progress into a competent phase. The theory suggests that one of the key factors that advances the learners from advanced beginner to competent stage is the introduction of taking responsibility for their behaviour. Taking responsibility will help transform and progress learners into the next level of expertise, as the learner will develop an understanding of their role in the system. On the other hand, resistance to taking responsibility can lead to stagnation and even regression in the skills development (Benner, 1984). Once learners reached the *competent* phase, they no longer rely on the safety of the detached, analytical rules, but instead they make use of situational information and take responsibility for their failures instead of attributing those to their insufficient knowledge of the rules. **Proficiency**

develops when extensive experience becomes integrated to one's skills in an atheoretical way, whereby the learner relies more and more on their experiential knowledge and situational discrimination, which leads to quicker performance of the skill. Finally, *experts* are able to immediately see what needs to be achieved and how to achieve it in a given situation due to their extensive experience and situational discrimination skills.

Previous studies on diagnostic reasoning generally differentiate between novices, intermediates and experts, where novices most commonly refer to undergraduate medical students during their first years of training, intermediates refer to postgraduate trainees with few years of clinical experience, and experts refer to clinicians with several years of professional experience. In a comprehensive literature review by Cuthbert et al., (1999), they concluded that **experts and novices differ** in several domains relating to diagnostic reasoning skills (Cuthbert et al., 1999), which include:

- 1) **hypothesis generation and evaluation**
- 2) **memory performance**
- 3) **diagnostic reasoning**
- 4) **knowledge organization**

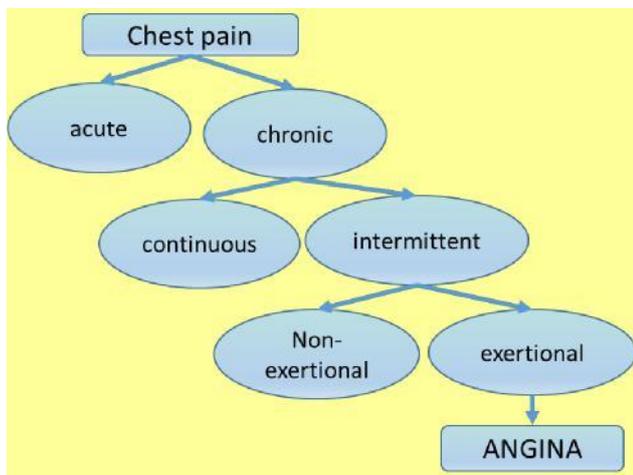
With regards to hypothesis generation, Sisson et al. concluded that experts generate fewer and broader differentials early on during the consultation than novices (Sisson et al., 1991). Early studies also suggested that experts generate more accurate hypotheses than novices (Neufeld et al., 1981a, Barrows et al., 1982, Gruppen et al., 1988). However, this assumption was contradicted in a more recent study by Krupat et al. (2017), where researchers found that there is no significant difference between the accuracy of early diagnostic hypotheses generated by novices, intermediates and experts (Krupat et al., 2017). Instead, diagnostic accuracy was associated with larger number of differentials considered, tendency to persist with requesting more patient information, and openness and willingness to change diagnosis in light of contradicting evidence (Krupat et al., 2017).

With regards to hypothesis evaluation, an early study from the 1990s found that undergraduate students with various degrees of experience tend to solve diagnostic problems differently (Arocha et al., 1993). They found that early novices (i.e. second year medical students) evaluate one hypothesis at a time, while intermediate (i.e. third year medical students) and advanced novices (fourth year medical students) tend to

evaluate several hypotheses at once (Arocha et al., 1993). Intermediate students were also seen to maintain hypotheses for long periods of time, being unable to eliminate them. They also generated different hypotheses for different findings, while advanced novices were able to generate multiple differentials for the same findings.

Other studies showed that experts tend to use more forward reasoning during diagnostic consultations, while novices tend to rely on backward reasoning when trying to narrow down their list of differentials (Patel et al., 1990, Young et al., 2007). In forward reasoning, the clinician moves from data through the use of semantic qualifiers and algorithms towards the hypothesis (See *Figure 3*) (Pelaccia et al., 2011). Semantic qualifiers refer to pairs of opposing adjectives that can help narrow down the list of possible differentials (Bordage, 2007b). In backward reasoning, on the other hand, the clinician starts by having a hypothesis in mind, and then collects data based on that hypothesis in order to see whether there is sufficient evidence for it in the patient's medical history.

*Figure 3: Example of forward reasoning strategy (Cooper et al., 2017)*



Memory recall studies also found differences between novices, intermediates and expert clinicians. One study found that experts were better at recalling diagnostically significant clinical information after being presented with a clinical case than the other two groups (Joseph and Patel, 1990). Another finding was that intermediates tend to outperform both novices and experts on memory recall tasks, which was referred to as the *intermediate effect* (Patel and Groen, 1991, Schmidt and Boshuizen, 1993b). This phenomenon has been explained by the knowledge encapsulation theory by arguing that experts' use of condensed, higher-level, illness scripts makes them less likely to recall

detailed patient information, while intermediates still relying on elaborate causal networks are more likely to engage in detailed recall (Schmidt and Boshuizen, 1993b).

With respect to diagnostic reasoning, experts were found to focus more on enabling factors than novices, and making use of enabling factors was directly related to their diagnostic success (Hobu et al., 1987). It was also found that when asked to ‘think aloud’ about clinical cases, novices tend to use extensive biomedical explanations in their narrative, while experts do not tend to use much biomedical explanation while solving routine cases (Patel et al., 1990). Experts are also likely to use cognitive shortcuts, also known as **heuristics**, such as representativeness and anchoring, while solving cases (Moskowitz et al., 1988). Recent research also suggests that experts can use heuristics with lower risk than trainees, because experts are better at error detection and error correction (Patel et al., 2011). The study has shown that while both trainees and experts are prone to diagnostic error, experts are better at both detecting and recovering from those errors. This implies that when experts’ use of heuristics may result in errors, they are more likely to identify and correct those errors, than medical trainees.

A recent study by Smith et al. (2014) also found differences in the diagnostic reasoning of early novices, intermediate novices, intermediates, and experts (Smith et al., 2014). They used concept mapping, propositional analysis, and grounded theory to compare the diagnostic performance of their participant groups. Their participants involved premedical students, first year medical students, third year medical students, second year residents and experts. The medical students were all from a medical school with a traditional curriculum structure, with two years of pre-clinical study followed by two years of clinical study (Smith et al., 2014). They found that during the early years of undergraduate training, medical students demonstrated a steady increase in the use of propositional rules and increasingly complex concept maps relating to the diagnostic process. They also found that from all the groups, the reasoning process of residents was the most analytic, using the largest number of propositional rules and the most elaborate concept maps. They tend to focus on the presenting complaints and order a large number of tests. They sometimes used personal episodic memories of previous similar cases. Experts’ reasoning was qualitatively different from the residents’. Experts tended to have more simplified concept maps, use less propositional statements, rely less on tests, and use fewer dimensions of the patient information for the diagnostic process. They placed equal emphasis on presenting complaints, previous exemplars and

physical examinations when trying to solve the patients' problem. However, when presented with a complicated case, they reverted to more analytic reasoning strategies. The authors interpreted these findings as supporting evidence for the knowledge encapsulation theory of medical expertise (Smith et al., 2014).

Finally, previous research findings also suggest that the knowledge organization of experts is different from that of novices. Studies have shown that experts were better at focusing on distinguishing features between illnesses with similar presentation, and better at considering hypotheses that involved similar clinical presentations, while sub-experts (i.e. physicians solving problems outside their own speciality) were more likely to consider hypotheses from different illness categories (Kushniruk et al., 1998). Relevant theories explain these findings by stating that the reasoning process of experts is schema driven. Kushniruk, Patel, and Marley (1998) proposed *the 'small world' hypothesis* to account for these findings (Kushniruk et al., 1998). They proposed that experts form discrete disease clusters, which contain diseases that share similar clinical presentation. They also are aware of distinguishing features that could differentiate between the various members of these clusters. They proposed these 'small worlds' of diseases are at the heart of expert diagnosticians' performance. This 'small world' hypothesis is closely related to other schema-based explanation of medical expertise, such as the knowledge encapsulation theory proposed by Schmidt and Boshuizen (1993) (Schmidt and Boshuizen, 1993a).

While these studies offer useful insights into the diagnostic thinking process of medical students, interns and expert clinicians, caution needs to be exercised when interpreting the findings due to the **heterogeneity of research design used**. Much of the empirical evidence about the diagnostic reasoning development of medical students is based on experimental, laboratory studies using written description of clinical cases (Cuthbert et al., 1999) or virtual cases (Klemenc-Ketis and Kersnik, 2014, Cook and Triola, 2009). However, it has been argued that these artificial, controlled studies move too far away from the complexity of real world scenarios and therefore these studies may not allow for valid conclusions about the actual diagnostic process that takes place in real clinical environments (Cuthbert et al., 1999). It has been also demonstrated that individuals reason differently when presented with a written description of clinical cases as opposed to virtual cases (Loke et al., 2011), which supports the argument that heterogeneity of research design could underlie the contradictory findings about diagnostic reasoning. Diagnostic scenarios utilizing virtual patients may have advantages over paper-based

exercises, as they are more interactive and thereby have higher authenticity. However, even virtual exercises mainly rely on written interaction, and lack an element of non-verbal communication. These limitations should be kept in mind when interpreting the findings of such studies. According to the most recent theories, the physical environment, the patient themselves, the human interaction with the patient, and non-verbal cues all have an important effect on the outcome of the diagnostic consultation (Gruppen and Frohna, 2002, Croskerry, 2009c). Therefore, real clinical scenarios and simulated scenarios with standardized patients in simulated environments may be the most valuable research approaches to study diagnostic reasoning.

It is also evident, that to date, most of the studies on diagnostic reasoning have looked at the difference between novice medical students, residents and experts, while there are very few studies that have looked at senior medical students approaching the graduation transition (Smith, 2015a). It is important to investigate the level of diagnostic reasoning skills in medical students approaching the graduation transition, because once they take on the junior doctor role, they will be expected to take charge of diagnostic consultations where they will have to rely on their diagnostic reasoning skills.

Finally, it has also been suggested, that researchers need to pay attention to the relationship between competence and performance (Rethans et al., 2002). There have been many studies that shown that doctors perform differently in controlled exercises where they are being tests compared to real clinical scenarios (Rethans et al., 1991, Ramsey et al., 1993, Ram et al., 1999, Page and Fielding, 1980). These studies show that there can be a **discrepancy between what clinicians are capable of doing and what they are actually doing in real practice**. Therefore, it is important to study diagnostic reasoning in settings that are realistic with low level of perceived assessment.

### **1.3.3 The role of context**

It has been long established in the field of cognitive psychology that contextual factors have the power to influence the cognitive processes. Through the past decades, it has been increasingly evident that contextual factors also play an important role in diagnostic consultations (Gruppen and Frohna, 2002, Croskerry, 2009c). The **theory of bounded rationality** states that humans are not ideal, rational decision makers, and therefore models of human decision-making need to take into account the environmental influences (Ferreira et al., 2010). Studies that look at diagnostic

reasoning in the real world are therefore very important and can improve our understanding of the complexity of these cognitive processes. Studies have shown that reasoning in the real world is far less analytic and rational than on paper (Ferreira et al., 2010). Standardized guidelines and real practices are often out of synch, mainly due to the inherent limitation of time, knowledge, working memory, and other resources (Ferreira et al., 2010). Clinicians may be discouraged from using standardized rules due to the complexity and the constraints of real clinical environments (Ferreira et al., 2010). They may resort to satisfactory decision through heuristics in favour of ideal ones based on complex decision-making rules. It has also been proposed that experts tend to adapt to their local environments rather than using standardized rules (Holtman, 2011). Such findings make it vital to conduct diagnostic reasoning studies that can incorporate the influence of contextual factors.

The role of contextual factors has also given rise to the notion of **context specificity of diagnostic reasoning** (Norman et al., 1985, Eva et al., 1998). It has been consistently found that performance on one clinical problem does not predict performance on a subsequent problem. Norman (1995) showed that performance of medical students and residents varies even when they are presented with problems with the same diagnosis, but different presenting complaints (Norman et al., 1985). These findings have prompted some researcher in recent years to explore the complex interaction of contextual factors and diagnostic reasoning in medicine (Durning et al., 2011b). They argue that in order to obtain a genuine understanding of the diagnostic reasoning in medicine, it is vital to take into consideration the context in which the clinical encounter takes place. The context here refers to (1) the setting, (2) the participants of the clinical encounter, i.e. the clinician and the patient, and (3) the interactions between patient, doctor and setting (Durning et al., 2010a).

There are two contemporary psychological theories that relate to the phenomenon of context specificity: *situated cognitive psychology* and *ecological psychology* (Durning et al., 2011). Both of these theories emphasize the importance of contextual elements in social cognition and social encounters such as a diagnostic consultation, and they argue that context and cognition should never be separated. They argue that cognitive processes are influenced by both the participants present in the given situation, as well as by the physical environment itself. This applies to both learning opportunities as well as clinical encounters.

*Situated cognition theory* states that there are complex interactions between the doctor, the patient and the setting during a clinical encounter that influences the cognitive processes of the doctor. This theory places equal emphasis on the actors and the environment in determining clinical performance: instead of considering the individual *in* the environment, it focuses on the individual *and* the environment (Durning et al., 2010a, Durning et al., 2010b, Bredo, 1994). This theory predicts that the outcome of a clinical encounter will never solely depend on the clinician themselves and therefore it is impossible to predict the outcome of the encounter based on the characteristics of the clinician alone. It predicts that the outcome of the clinical encounter will be determined by the complex interactions between the clinician, the patient, and the setting. This theory is also consistent with the cognitive load theory. Durning et al. (2012) has explored the interaction of **cognitive load theory and situated cognition** in clinical encounters (Durning et al., 2012). They investigated how the diagnostic reasoning of expert clinicians' changes when modifying various patient, clinician and encounter factors. They predicted that modifying certain factors would change the cognitive load of the tasks, which in turn would influence performance. Their study confirmed that various contextual factors, such as limited time, atypical presentation, diagnostic suggestion, and the use of semantic qualifiers could influence the clinical encounter of expert clinician. Based on their findings they further predict that these influences may be even stronger for novices and intermediates.

While situated cognition theory highlights many important aspects of the role of contextual factors in clinical encounters, even this approach fails to account for some of the factors that according to other perspectives are likely to influence clinical encounters, such as goals, values and intentions as driving force of human behaviours. Ecological psychology on the other hand is an approach, which takes all of these factors into account. The basic principles of *ecological psychology* state that the context can be defined in terms of affordances and effectivities (Durning et al., 2011). *Affordances* refer to all that the physical environment can provide in a given situation. They are opportunities and possibilities that the environment can supply. In order to make the most of the affordances, the individual needs to direct their *attention* towards the potential environmental affordances. *Effectivities*, on the other hand, refers to what an individual can potentially do in a certain environment. These effectivities depend on the participants' skills and abilities. Through these affordances and effectivities, the physical environment influences the participant's cognitions and behaviour. The

complex interactions between affordances, effectivities, the participants' attention, intentions and goals together will determine the outcome of the clinical encounter. Although the interaction between cognitions and the context is recognized by these theories, at present, little is known about the particularities of their interaction. However, it seems clear that due to the complex and powerful effect that the contextual factors have on cognitive processes, tasks and assessments which test diagnostic reasoning in an acontextual way may have very different outcome than those which do so in a clinical context (Gruppen and Frohna, 2002). Acontextual tasks, such as paper-pen based exercises are less complex than their clinical equivalents and therefore have a reduced cognitive load. According to the *cognitive load theory*, this type of exercises can facilitate learning during early years of training, because novice students have less developed cognitive schemas which are more affected by cognitive load (Durning et al., 2011). However, skills that are exclusively learnt through acontextual exercises may not transfer well to the real clinical environment. Therefore, to facilitate transfer of skills, training should gradually increase in complexity and increasingly resemble the complexity of the clinical environment.

Another important implication of these theories on diagnostic reasoning research is that various clinical settings may influence clinical encounter outcomes in different ways. A primary care setting will be inherently different from a hospital ward or emergency department setting. The physical environment, the availability of resources, the patient's problems, the healthcare team, priorities and expectations are all very different in these two settings. Therefore, it is not surprising to expect that these settings may have very different effects on the thinking process of medical professionals. For this reason, it is important for studies investigating the cognitive processes of medical professional to describe the setting in which the diagnostic scenario took place. The present study focuses on primary care setting.

### ***1.3.3.1 Primary care setting***

When the NHS was founded in 1948, a new role for general practitioners was established, as primary care was made free and available for everyone in the UK. Easy accessibility inevitably meant that demand for primary care services rocketed. In order to determine how to deal with these new demands, and to provide support and guidance for general practitioners, the College of General Practitioners was established in 1952.

Shortly after, general practitioners started to realize that they are faced with a dilemma around the practicalities of diagnostics in primary care (Morrel, 1993). In the 1950s, it was considered inappropriate, almost immoral for doctors to start treatment for a patient before reaching a definite diagnosis (Morrel, 1993). However, **general practitioners** soon began to realize that **they could not apply the same biomedical diagnostic model that their colleagues working at hospital settings were using** at the time.

The biomedical model is based on a number of fundamental assumptions (Wade and Halligan, 2004). *First*, it defines health as the absence of disease. *Second*, it states that every illness is caused by an underlying physical abnormality in the body. *Third*, it assumes that psychological and social factors do not have an influence on illness presentation or illness progression. Therefore, when doctors use the biomedical model in secondary care, they are determined to find the physical pathology that causes the illness in order to choose the appropriate treatment regime.

However, this model is highly problematic when applied to primary care, because there are **fundamental differences between the diagnostic characteristics of primary care and secondary care patients** (Morrel, 1993). First of all, due to the easy accessibility of primary care services, patients in primary care are often at very early stages of their illness. These illnesses are often self-limiting and do not require the formulation of a diagnosis in pathological terms. On the other hand, GPs also routinely deal with chronic, long-term conditions with comorbidities where diagnosis has been long established. Many patients present with undifferentiated, vague symptoms caused by relatively innocent, minor illnesses. However, one of the challenges that general practitioners have to face is to identify the occasional, serious cases. Also, due to time pressure and limited resources in terms of diagnostic tests, general practitioners often cannot reach a definite diagnosis during the consultation. According to a study by Heneghan et al. (2009), GPs reach a definite diagnosis in less than 50% of cases (Heneghan et al., 2009).

The realization of these differences was supported by a growing number of morbidity studies, which showed that there was a weak correlation between the presenting symptoms in primary care and their expected biomedical causes (Wasson et al., 1981, Tuckmann et al., 1962, Ridsdale et al., 1993). When trying to find the underlying cause of this finding, researchers realized they have to look at the reasons why some patients seek help from primary care services, while others with similar symptoms do not. This

inquiry led to a collaboration between general practitioners and social scientist in the 1960s and 1970s. Together they found that there appeared to be no correlation between the severity or nature of the illness and whether the patient visited healthcare services. The answer to why certain patients sought medical help why others did not were more likely to be related the psychological and social background of the patient, their personality traits, their expectations towards the consultation, and the doctor's response to the patient's problems. This finding was yet another contradiction to the biomedical model of diagnosis. These discoveries all contributed to the emergence of a patient-centred, holistic, bio-psycho-social model of diagnosis in primary care that is still in use today.

Despite advancements in the understanding of the characteristics of the patient population presenting in primary care, it is still regarded as a challenging diagnostic domain.

Physicians working in primary care see a **highly diverse population of patients, often with general, undifferentiated symptoms**. They need to manage patients' problems under time pressure, while having limited access to diagnostic tests compared to ward environments. Due to the aging population, they also regularly need to deal with the effects of comorbidity and multi-pharmacology. Due to these challenges, it is not surprising that **medical errors occur frequently** (Panesar et al., 2014). According to recent statistics, in primary care 1 in 50 encounters results in a patient safety incident, and of these 1 in 20 results in substantial harm to the patient (Panesar et al., 2014).

Considering that there are over 340 million general practice consultations per year in the UK, the above statistics implies that round 300,000 patients per year experience substantial harm in general practice (Panesar et al., 2014). These statistics illuminate the importance and necessity for further research that could improve the understanding of the diagnostic process in primary care.

#### ***1.3.3.2 Diagnostic reasoning in primary care***

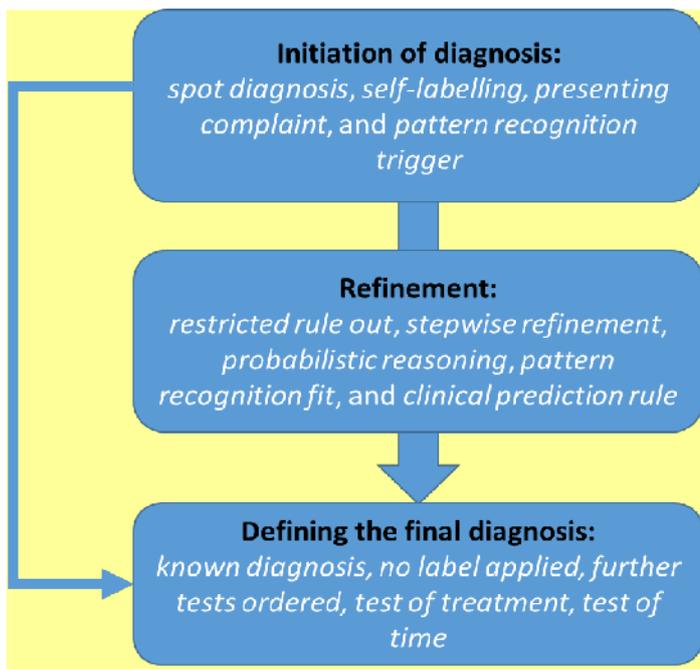
Due to the distinct characteristics of primary care setting, it is important for researchers to study the diagnostic process in this context. In an early study by Rudebeck (1992), they investigated the difference between diagnosis in theory and diagnosis in primary care practice (Rudebeck, 1992). They proposed that, in theory, symptoms relate to illnesses in a logical, objective way. However, in practice, patients experience and present their symptoms in a personal way, enriched by psycho-social cues. They have involved 33 GPs, and 11 GP trainees and locums in their study. Participants were asked

to look at a case study in a written form and formulate their diagnosis based on that. Afterwards, they were shown the same clinical case in video format, and were asked to formulate their diagnostic opinion one more time. They found that participants judged symptom presentations differently, and psychosocial causes were rated more important after viewing the video. They also found that more experienced GPs were more likely to change their judgements about causal factors after viewing the video. They concluded that patient's personal and social characteristics influenced diagnostic judgement.

Some more recent studies focused on the element of uncertainty that clinicians have to deal with in primary care setting. In one article by Schneider et al. (2010), researchers administered a questionnaire to 325 GPs in Germany in order to measure how GPs deal with uncertainty (Schneider et al., 2010). They found that intolerance against uncertainty correlates with increase of diagnostic activity (i.e. ordering more diagnostic tests). In a later, follow-up study by Schneider et al. (2014), they have administered a questionnaire to 228 GPs in Germany to investigate the influence of personality traits on diagnostic reasoning in primary care (Schneider et al., 2014). They have found that neuroticism was positively associated with 'anxiety due to uncertainty', while 'extraversion', 'agreeableness', 'conscientiousness', and 'openness to experience' were positively associated with 'communicating uncertainty'. These findings demonstrated that personality traits can influence how clinicians respond to and deal with uncertainty in primary care.

A study by Heneghan et al. (2009) examined the diagnostic reasoning strategies used by experienced clinicians in primary care. This study is the first to identify and characterize the cognitive strategies use in real clinical practice. The summary of their main findings is shown in Figure 4 (Heneghan et al., 2009).

Figure 4: Diagnostic strategies used in primary care (Heneghan et al., 2009)



In the study, the authors have identified three stages of the diagnostic process in primary care: the *initiation phase*, the *refinement phase*, and the final *defining phase*. They found that each of these stages was characterized by different diagnostic strategies. First, they identified four strategies in the initiation phase: *spot diagnosis*, *self-labelling*, *presenting complaint*, and *pattern recognition trigger*. In spot diagnosis, the clinician almost instantaneously recognizes the illness based on some non-verbal cue, such as a visual (eczema) or auditory (barking cough) symptom. Self-labelling involves the patient telling the physician what they think the diagnosis is, which may or may not be correct, but definitely directs the consultations. Presenting complaint (such as I have a headache) is the most often used by GPs. Finally, pattern recognition trigger means when parts of the history or examination triggers a hypothesis that is based on the physician's previous experience with that particular illness.

Once the initiation phase is over, the GP can either decide to accept the diagnosis reached at this phase and proceed to management, or use refinement strategies to narrow down the possibilities for the diagnosis. Refinement strategies include *restricted rule out*, *stepwise refinement*, *probabilistic reasoning*, *pattern recognition fit*, and *clinical prediction rule*. Restricted rule out is a strategy aimed at preventing serious diagnostic error in primary care and it is based on knowing the most common causes associated with the presenting symptom that need to be ruled out. Stepwise refinement is another strategy, which involves refinement of the diagnostic possibilities based on either the

location of the problem or the generally considered underlying cause. Probabilistic reasoning is based on the Bayes' Theorem. In the 18th century, Reverend Thomas Bayes came up with a mathematical model for updating probabilities of an outcome as a result of additional information. Based on his statistical approach doctors can calculate the probability of an illness by examining the probability of each symptom in relation to an illness, and by taking into account the pre-test probability of the illness and the accuracy of the diagnostic test (Doust, 2009). Although in theory this strategy could provide a precise solution to diagnostic problems, in reality it has many pitfalls. Pattern recognition fit is the most commonly used refinement strategy in primary care, and it involves the comparing of the pattern of presenting symptoms with previously encountered symptom patterns. In pattern recognition fit no specific rule is used, it implies a reliance on the memory of illness patterns. Finally, clinical prediction rule is the more formal version of pattern recognition, where the pattern is based on a series of acknowledged similar clinical cases, on an international level. The refinement phase can lead to a definite diagnosis when the GP has sufficient certainty in their judgement. There is a difference between the degree of certainty required for applying a diagnostic label in primary care as opposed to in a hospital setting. In primary care, when an illness is spotted, it is important to start treatment and referral as soon as possible, while in secondary care, treatment will be preceded by a series of diagnostic tests and examinations in order to precisely define the classification of the illness.

In the study by Heneghan et al., less than 50 per cent of the cases resulted in a defined diagnosis (Heneghan et al., 2009). When a diagnostic label is not applied, it can signal the absence of a substantial or serious condition as far as the clinician is concerned. In other cases, it can leave the door open for further investigations to follow. Therefore, the diagnosis in general practice at this stage often signifies a decision point. Heneghan et al. identified three further strategies by GPs in this final definition stage of diagnosis. These strategies involve ordering further tests, test of treatment and test of time. When the pattern of symptoms does not fit any obvious pattern, the clinician may decide to order further diagnostic tests in order to reach a diagnosis. Further test may also be used to follow up “red flags” - symptoms that may signal serious conditions. Another strategy when the GP is uncertain about the diagnosis is the test of treatment which involves prescribing a treatment for the suspected condition and monitoring the response to treatment which can confirm or refute the diagnosis. Finally, GPs can apply the test of time, which is a “wait and see” strategy. These latter two strategies involve treatment prior to definite diagnosis, which although contradicts the classical sequential

model of diagnostic reasoning (i.e. first diagnosis, then treatment) they are used frequently in primary care.

A recent article by Goyder et al. (2015) involved the secondary analysis of 36 qualitative interviews with GPs in UK (Goyder et al., 2015). The participants have identified key learning points for GP trainees with regards to the diagnostic process. They agreed that GPs tend to “*think in patterns rather than in diagnoses*”. They also found that atypical symptom presentation that does not fit any pattern can lead to diagnostic errors. They point out that trainees are at particular risk of this, because they have limited illness patterns to rely on. On the other hand, the more experienced the GP is, the more likely it is that an atypical presentation should ring alarm bells, since they already possess a large number of illness scripts.

GPs felt that ruling out serious conditions (i.e. restricted rule-out) could be even more important than coming up with the right diagnosis in primary care. However, trainees may struggle with this approach, as they are determined to make a diagnosis partly due to the associated feeling of success and competence. Also, trainees may struggle with the rule-out rules, because they do not necessarily know how to use those rules correctly and they run the risk of ruling out something that should not be ruled out based on the findings. They point out that the proper use of rule-out rules require knowledge about the diagnostic accuracy of tests in primary care setting. They also stated that failing to identify a ‘red flag’ can lead to error, while taking into account the ‘sense of unease’ of the doctor, concerns of the patients, and parental concern could help avoid diagnostic errors. They agreed on the importance of safety netting. Finally, they emphasize that GPs need to accept the inevitable uncertainty that comes with their diagnostic tasks. However, the level of tolerance to uncertainty may differ from individual to individual, perhaps based on their personality. However, it should rather be dependent on the seriousness of the possibly missed diagnosis. Although these findings were not based on primary data analysis, it has important implications and useful learning goals for postgraduate primary care training.

Finally, a qualitative study by Balla et al., which involved semi-structured interviews with 15 GPs in UK, found that cognitive errors are most likely to happen at the beginning and at the end of the cognitive diagnostic process (Balla et al., 2012). They also found that the lack of knowledge is an important factor in diagnostic error in primary care. However, this contradicts the findings of previous studies which attributed

diagnostic errors to biased reasoning rather than lack of knowledge (Graber et al., 2005, Singh et al., 2007).

While these findings provide useful hints for the direction of training in primary care, it is equally important to explore how medical students actually think during primary care consultations. Only through such research can their true learning needs be identified and the most suitable instructional strategies developed to improve their diagnostic reasoning skills.

#### **1.3.4 Diagnostic reasoning in medical education**

Despite the fact that the importance of diagnostic reasoning for safe clinical practice has been well-established over the past decades, it is yet to be systematically integrated into the medical curriculum in the UK. Historically, diagnostic reasoning has not been recognized as an explicit educational target in medical education, instead it has been viewed as a trait that naturally emerges over time (Norman, 2005b). However, this view has been challenged over the past 20 years, and experts now argue that diagnostic reasoning is a skill that could and should be addressed in the medical curriculum (Ajjawi and Higgs, 2008, Schmidt and Rikers, 2007, Thierry et al., 2011, Kassirer, 1995). However, medical educators are puzzled as to which educational intervention to use and how to integrate it best into the medical curriculum. Therefore, currently, diagnostic reasoning is largely part of the ‘hidden curriculum’ in medical education – it is a trait that medical students are expected to develop, but are not explicitly taught during their training (Malhotra et al., 2009, Howe et al., 1984, Chessare, 1998, Levine, 2014, Round, 1999).

A recent report by Page et al. (2016) found that medical schools claim to deliver diagnostic reasoning training as part of small group sessions (tutorials or PBL sessions), clinical and communication skills sessions, and primary care placements (Page et al., 2016). However, it was unclear for the respondents of the study whether clinical reasoning was explicitly taught through these modalities, or only assumed to be taught, without explicit guidelines or standardized methods being in place. The study by Page et al. (2016) also found that when it comes to assessment, most medical schools indicated that they use OSCEs and multiple-choice written exams to assess clinical reasoning (Page et al., 2016). A smaller percentage indicated the use of “long cases and short answers” type assessment. The authors called attention to the issue that **although**

**OSCEs may be the best available assessment method for clinical reasoning, it may not be an optimal one.**

It is also important to keep in mind that today's medical educators and clinical supervisors have not received diagnostic reasoning training during their medical training either, which implies that they might not possess the vocabulary to effectively teach these skills. Research has shown that experienced clinicians often have limited explicit insight into their own reasoning processes, which could make it difficult to pass them onto the students (Mehdizadeh, 2011). Therefore, in order to effectively implement diagnostic reasoning training into medical education, training needs to target supervisors, educators and students alike. Shifting diagnostic reasoning to the 'formal curriculum' could help equip both medical educators and students with the necessary vocabulary to reflect upon these skills (Malhotra et al., 2009).

There are some fundamental reasons why **diagnostic reasoning is a challenging educational target**. *First*, despite decades of research, there is still a lack of consensus on the theoretical model of diagnostic reasoning (Norman, 2005b). Research so far has mainly focused on comparing the clinical reasoning skills of novices and experts, while the developmental trajectory of this skill is poorly understood.

*Second*, as it was described earlier, research findings suggest that diagnostic reasoning is highly dependent on its context and the content of the clinical case. Therefore, there does not appear to be one single universal reasoning strategy that can be used in all circumstances. The key to expert diagnostic reasoning seems to be the flexible use of various strategies.

*Third*, there is a scarcity of empirical research comparing the effectiveness of various educational programs targeting diagnostic reasoning, and little agreement among medical educators on effective interventions (Mehdizadeh, 2011). There is also very limited research on where in the medical curriculum diagnostic reasoning training should be implemented in order to achieve optimal results. So far, research has mainly focused on assessing the effectiveness of diagnostic reasoning trainings during the pre-clinical years, while the clinical years and foundation years remain largely under-researched. However, due to the increased exposure to clinical experience during these years, they may provide ideal opportunities for teaching diagnostic reasoning skills to medical students.

*Fourth*, it is unclear what effect curriculum design has on the diagnostic reasoning development of medical students. Some studies claim that the introduction of the integrated curriculum had a positive effect on the diagnostic reasoning skill development of medical students. One recent study by Diemers et al. (2015) found improved diagnostic accuracy and improved quality knowledge networks after a 10-week course involving real patient contact for third year medical students (Diemers et al., 2015). Another study investigated the effect of traditional versus Problem Based Learning (PBL) curriculum on the diagnostic reasoning skills of senior medical students (Goss et al., 2011). They found that students following the traditional curriculum outperformed the ones from PBL curriculum. Due to this unexpected finding, the authors recommended caution and continuous competency assessment during curriculum changes in medical education. On the other hand, other studies found no significant effect of curriculum design on diagnostic reasoning skills of medical students (Williams et al., 2011, Silva and Silva, 2013, Silva, 2013). In light of these contradictory findings, continued research is necessary.

*Finally*, although traditional classroom-based interventions for teaching diagnostic reasoning skills are of value, experts claim that these may not be sufficient given the tacit, context-dependent nature of this skill (Norman and Eva, 2010, Nendaz and Perrier, 2012, Teunissen and Westerman, 2011b, Teunissen and Westerman, 2011a). It has been suggested that teaching medical students about the analytic and non-analytic processes involved in diagnostic reasoning and the biases they are subject to can have a positive effect on their diagnostic accuracy (Marcum, 2012, Eva et al., 2007, Eva, 2005). However, Norman & Eva (2010) pointed out that empirical findings of these types of interventions show only limited improvements in diagnostic accuracy (Norman and Eva, 2010). It is suggested that in order for diagnostic reasoning to significantly improve, students need to expand their pool of exemplars, which can be achieved through repeated patient encounter. Therefore, in addition to educating students about the theoretical models of diagnostic reasoning, it is also important that they gain sufficient experience through opportunities to practice diagnostic reasoning.

This suggests that **the effective teaching of diagnostic reasoning skills needs to involve a practical element in a clinical setting** (Eva, 2005). At the same time, it is important that practicing these skills does not compromise patient safety. Therefore, medical educators are faced with a dilemma: medical trainees need to have repeated

access to patients in order to develop diagnostic competence, but without compromising the safety of those patients (Kalaniti and Campbell, 2015, Ziv et al., 2003). Consequently, it appears that the use of simulated patients may be an essential tool for aiding the development of diagnostic competence in a risk-free environment. However, further research is needed in order to know which simulation techniques are most effective for this purpose.

However, Marcum (2012) points out that repeated exposure to various illnesses, of itself is not sufficient to develop diagnostic competence (Marcum, 2012). In order for expertise to develop, individuals need to make use of their metacognitive feedback. **Metacognitive feedback** in diagnostic reasoning refers to the clinician's inward reflection, by which they can become conscious of their own reasoning processes, become aware of their own mistakes, and can identify areas of improvement. This way, a clinical encounter changes from being a passive situation into becoming a mindful experience that is consolidated and evaluated, which in turn will guide and correct future diagnostic reasoning behaviour (Marcum, 2012).

Similarly, Ericsson et al. (1993) previously argued that repeated practice itself does not automatically transform into expertise, stressing the importance of 'deliberate practice' as the cornerstone of developing expertise (Ericsson et al., 1993). **Deliberate practice** is a purposeful activity aimed at optimal learning and development of expertise in a certain field. The characteristics of deliberate practice involve motivation, repeated task performance, immediate feedback, and a set of carefully designed tasks that take into consideration pre-existing knowledge and level of experience of the learner (Ericsson et al., 1993).

To sum up, in order to effectively teach diagnostic reasoning skills, students need to be aware of the different reasoning strategies and the associated biases, they need experience guided by the principles of deliberate practice and feedback, and they need to use metacognitive reflection in order to optimize their learning gains. Classroom-based teaching is suitable for teaching the theoretical models of diagnostic reasoning, cognitive and affective biases and the importance of metacognition. Deliberate practice, feedback and reflection can be facilitated through SBME (McGaghie et al., 2010).

### 2.1 INTRODUCTION

Chapter 2 presents a review of the literature on the diagnostic skills of senior medical students and newly graduated doctors in primary care setting. Previous research on diagnostic reasoning has predominantly focused on either the early years of medical training or on experts with several years of clinical experience. However, there is a scarcity of studies exploring how senior medical students and newly qualified doctors solve diagnostic problems. Considering that contextual factors may have a significant effect on diagnostic reasoning, the present literature review is limited to a single speciality setting, primary care. The primary care setting can be an especially challenging environment for medical trainees with limited clinical experience due to the vague and non-specific presentation of clinical problems.

The first literature review in this chapter focuses on the diagnostic reasoning skills of senior medical students and newly qualified doctors relating to primary care. The second literature review focuses on the use of simulation techniques to explore the diagnostic skills of senior medical students and newly qualified doctors. The aim of these two reviews was to provide a comprehensive overview of the available evidence from a wide range of studies, in simulated, real, or experimental settings. The literature review provided a summary of the findings and highlighted gaps in the literature to provide guidance on further research opportunities in this area.

## 2.2 THE SCOPE OF THE LITERATURE REVIEWS

The aim of the present literature reviews was to explore the existing literature and identify gaps in knowledge to demonstrate how the present research complements and builds on existing findings. This type of scoping review aims to pave the way for future research (Jesson, Mathenson, Lacey, 2011).

During the literature review process, seven different databases were identified by the researcher as relevant for the topic of the reviews. The search terms were kept broad enough to capture all potentially relevant literature, but specific enough to keep the search manageable within the scope of the study. The search was limited to English language articles due to unavailability of translation services within the scope of the present study.

For both reviews, the following inclusion criteria was applied:

- (a) involves relevant, primary data collection,
- (b) focuses on primary care setting or primary care problems,
- (c) involves an element of diagnostic skills, and
- (d) the main purpose of the study is not the evaluation of an instrument or assessment tool.

Besides the literature review, the researcher attended relevant medical education conferences during the time of the project to keep informed about relevant research projects taking place in the UK. The researcher has also attended the most recent conference held by the UK Clinical Reasoning in Medical Education Group (CReME) to be informed about recent research endeavours within the UK in the field of clinical reasoning.

Attending relevant conferences, together with conducting the scoping review revealed that the number of studies in this area was very limited. The use of critical appraisal tools for quality control was originally considered for the literature review, however, due to the small number of available articles on the topic, inclusion rather than quality control was the researcher's main priority. The small number of relevant articles made it feasible to include all of the identified articles in the review without further restrictions based on quality. Basic quality control was ensured by only including articles from peer-reviewed journals.

The literature review has identified that the studies in this area were very diverse in terms of research question, methodology, context, and participants. The scarcity and methodological heterogeneity of the relevant studies would have made the meta-analysis of the findings problematic and would have limited the usefulness of a systematic approach. Therefore, a systematic review has not been undertaken, but it was ensured that the scoping review was conducted in a transparent way, clearly stating the databases involved, search terms used, and inclusion criteria applied. Such literature review approach is consistent with the use of qualitative, interpretative paradigms as the one adopted in the present study (Jesson, Matheson & Lacey, 2011).

### 2.3 MEDICAL TRAINEES' DIAGNOSTIC SKILLS IN PRIMARY CARE

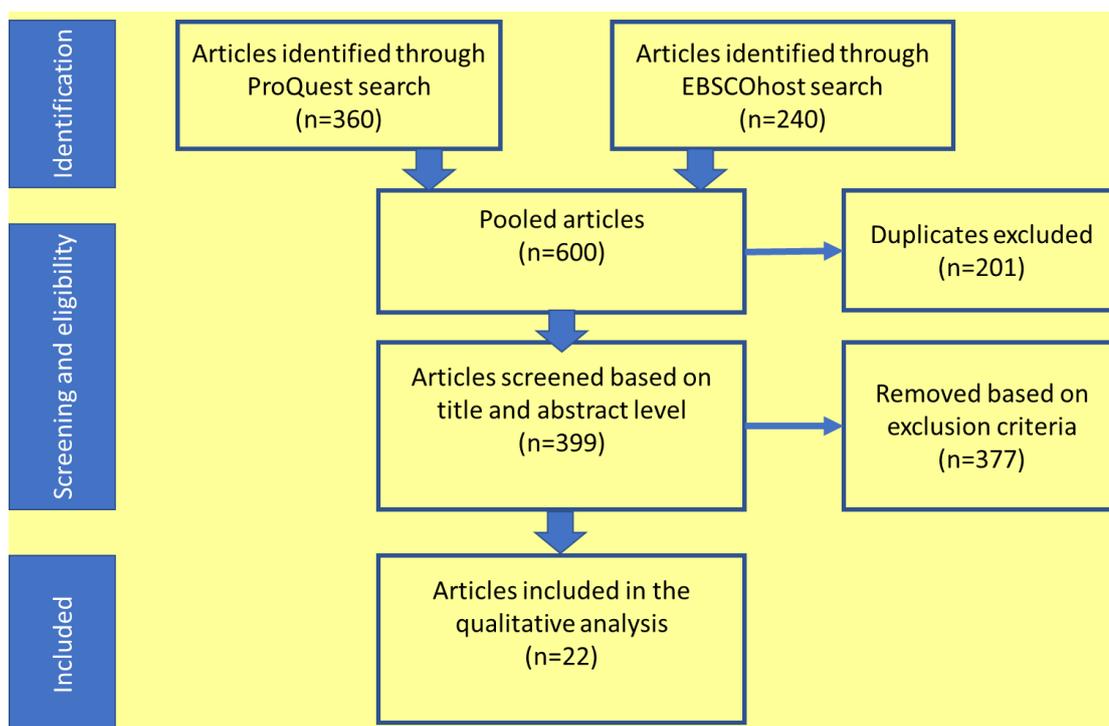
The aim of the first literature review was to identify existing literature that focused on the diagnostic skills of senior medical students and newly qualified doctors relating to clinical problems that are relevant to a primary care setting. A literature search was conducted using the following search terms: ("medical students" or "medical education" or "medical training" or "Foundation doctors" or "Foundation program" or "undergraduate" or "postgraduate" or "foundation year") AND ("general practice" or "primary care" or "family practice" or "family medicine" or "GP") AND (diagnostic\* or "reasoning" or "decision making" or "judgement" or "problem solving") (See *Table 2*). All these key words were restricted to abstract level search. Due to the heterogeneity of terms used to describe diagnostic reasoning in various articles, the search terms relating to diagnostic reasoning predominantly involved broad cognitive terms. The ProQuest and EBSCOhost search engines were used to facilitate the literature review. The databases in the ProQuest search included MEDLINE, PsycARTICLES, and ProQuest Dissertations & Theses Global. The databases involved in the EBSCOhost literature search were the PsycINFO, Cumulative Index to Nursing and Allied Health Literature, Educational Resources Information Center, and the British Education Index.

**Table 2:** Literature review key words focusing on the diagnostic skills of senior medical students and newly qualified doctors relating to clinical problems that are relevant to a primary care setting

primary care OR general practice OR GP	AND	medical students OR medical education OR medical training OR Foundation doctors OR Foundation program OR undergraduate OR postgraduate OR foundation year	AND	diagnostic* OR reasoning OR decision making OR judgement OR problem solving
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The initial ProQuest search identified 498 articles. From these, 360 were peer-reviewed, English language articles published between 1975 and 2018. The EBSCOhost search initially identified 271 articles, from which 240 were English language, peer-reviewed papers, published between 1972 and 2018. The articles from the ProQuest and EBSCO search were pooled and 201 duplicates were removed. The remaining 399 articles were reviewed on title and abstract level. The inclusion criteria involved studies that (1) involved primary data collection, (2) involved participants who were either medical trainees within two years before or after their graduation, (3) involved a primary care element, (4) involved a diagnostic skill element, and (5) whose main purpose was not the evaluation of an intervention or assessment tool. Based on these criteria, 286 articles were excluded because they did not involve primary data collection relevant to primary care setting involving medical trainees who were within two years pre- or post-graduation. Another 44 articles were excluded because they did not involve an element of diagnostic skill element, and a further 47 were excluded because their main aim was the evaluation of an intervention or assessment tool. The remaining 22 articles were included in the review. The screening process is outlined on *Figure 5* and the relevant articles are summarized in *Table 3*.

**Figure 5:** *The screening process for the literature review focusing on the diagnostic skills of senior medical students and newly qualified doctors*



*Table 3: The summary of articles investigating the diagnostic performance of senior medical students and newly qualified doctors*

Source	Study location	Study population	Main theme	Main measure	Relevant findings
(Rogowska-Szadkowska and Chlabicz, 2010)	Poland	Senior medical students	Gaps in medical knowledge	Questionnaire	They found that senior medical students have gaps in their knowledge relating to HIV/AIDS symptoms that would present in primary care setting, which perhaps contribute to delayed diagnosis.
(Esparaz et al., 2014)	USA	Senior medical students	Gaps in medical knowledge	Standardized, 12-question quiz	They found insufficient knowledge of fourth year medical students regarding ocular conditions in primary care. Students showed especially poor knowledge relating to the management of such conditions.
(Shah, 2001)	UK	Senior medical students	Gaps in medical knowledge	10-item questionnaire	They found that fourth year medical students lack knowledge about the possible causes, prognosis, treatment and IQ profile relating to autism. Therefore, it is suggested that further training about autism is necessary in order to facilitate the diagnosis and management of autism in primary care.
(Mann et al., 2017)	Canada	Postgraduate medical trainees	Gaps in medical knowledge	E-mail survey	They found that there are gaps in knowledge about concussion diagnosis and management among family medicine residents.
(Parada et al., 2005)	USA	Senior medical students and postgraduate medical trainees	Gaps in medical knowledge	Self-administered knowledge survey	They found that both senior medical students and residents lack key blood culture related knowledge. This was important, because when looking at medical trainees at various training level, these two groups were most likely to order such tests during the diagnostic process, suggesting that there is a strong need to improve their knowledge base for using such diagnostic tests.
(Carlson and Dachs, 2015)	USA	Postgraduate medical trainees	Cost awareness	Survey	They found that family medicine residents remain largely unaware of the hospital charges associated with common diagnostic laboratory and radiology tests.

<b>Source</b>	<b>Study location</b>	<b>Study population</b>	<b>Main theme</b>	<b>Main measure</b>	<b>Relevant findings</b>
(Bornstein et al., 1999)	USA	Postgraduate medical trainees	Cost awareness	Survey	They found that residents were not influenced by the amount of time and money already invested in the patient's treatment when making decisions about their future management plan.
(Walzman et al., 2015)	UK	Postgraduate medical trainees	The influence of general practice placement on diagnostic skills	Questionnaire	They found that according to Foundation Year 2 participants, their general practice placement improved their clinical decision-making skills.
(Lloyd and Rosenthal, 1992)	UK	Senior medical students	The influence of general practice placement on diagnostic skills	Questionnaire	They found that fourth year medical students have positive perceptions about their general practice placements. Students stated that the areas they gained most during their general practice placements were diagnostic decision-making skills and understanding the psychological and social aspects of illness.
(Schwiebert et al., 2009)	USA	Senior medical students	The influence of general practice placement on diagnostic skills	Narrative feedback upon completion of their compulsory family clerkship placements	They found that students thought their family medicine placements helped them develop better skills at clinical decision making, differential diagnoses and focused patient evaluation.

<b>Source</b>	<b>Study location</b>	<b>Study population</b>	<b>Main theme</b>	<b>Main measure</b>	<b>Relevant findings</b>
(Ramanayake et al., 2015)	Sri Lanka	Senior medical students	The influence of general practice placement on diagnostic skills	Questionnaire	They found that according to senior medical students' experiences, family medicine placement help them improve their problem-solving skills, analytic thinking skills, and history taking skills.
(Svenberg et al., 2007)	Sweden	Senior medical students	Perceptions and experiences of primary care consultations	Students' reflective commentaries of a memorable general practice consultations	They found that students realized that often the presenting complaint of the patient is not the real reason for their GP visit and therefore it is important to explore their background. Students showed an understanding that clinical cases are often complex and involve a level of uncertainty. They showed emerging awareness to keep an open mind and not try to withhold jumping to diagnostic ideas too soon. Finally, they found their supervisors to be important role-models during this stage of their training.
(Haffling et al., 2010)	Sweden	Senior medical students	Perceptions and experiences of primary care consultations	Students' portfolio reflections of their general practice placements	They found that students often struggle with time management and clinical reasoning in primary care consultations. They found it difficult to translate their theoretical skills into clinical practice and to apply their knowledge base for non-specific complaints presented in primary care. Some students doubted their knowledge base, finding it difficult to come up with differentials, and many lacked knowledge for formulating management plans. Some students also identified communication skills as an area they need to improve. Students recognized the importance of active listening and rapport building, and they reflected on their improved ability to address sensitive issues as a sign of their professional development.

Source	Study location	Study population	Main theme	Main measure	Relevant findings
(Klemenc-Ketis and Kersnik, 2014)	Slovenia	Senior medical students	Strength and weaknesses of consultation skills	Scores based on the written reports of solving virtual cases.	They found that fourth year medical students were good at the initial assessment of the complaints, but less competent with regards to patient education and patient involvement.
(Petek Ster et al., 2014)	Slovenia	Senior medical students	Strength and weaknesses of consultation skills	Questionnaire	They found that while final year medical students were aware of the patient-centred, holistic management approach in primary care, they need further training in problem-solving skills and decision-making processes that are characteristics of primary care physicians.
(Hastings et al., 2006)	UK	Senior medical students	Strength and weaknesses of consultation skills	Observing medical students during general practice consultations and judging their performance against a modified version of the Leicester Assessment Package by two assessors	They found high level of heterogeneity in final year medical students' consultations skills. They identified several strengths and weaknesses relating to primary care consultations skills. They found that the most frequently identified strengths were related to interpersonal skills, while the most frequently identified weaknesses were related to clinical problem-solving.

Source	Study location	Study population	Main theme	Main measure	Relevant findings
(Liddell and Koritsas, 2004)	Australia	Senior medical students	Factors influencing diagnostic performance	Questionnaire and OSCE scores	They found significant differences in performance, with students of Non-Western ethnic background performing consistently poorer in all assessment parameters than Western born students.
(Vajer et al., 2010)	Hungary and Switzerland	Senior medical students	Estimates and certainty judgement	Questionnaire	They found that medical students and residents estimate COPD risk and congestive heart disease risk lower than experts.
(Dory et al., 2010a)	Belgium	Postgraduate medical trainees	Estimates and certainty judgement	Written multiple choice question test, where each answer was followed by a degree of certainty judgement	They found that a sixth of participants showed signs of hazardous ignorance, which meant they gave the wrong answer for the MCQ tests and rating that answer with high level of certainty.
(Leblanc et al., 2002)	Canada	Postgraduate medical trainees	Direction of the reasoning process	Participants were asked to identify clinically relevant features in written case history and judge the plausibility of the tentative diagnosis	They found that second year medical students and residents were equally susceptible to the biasing effect of a suggested diagnostic hypothesis, which seem to indicate that both groups rely on backward reasoning strategies. They explained that if residents were using more forward reasoning than students, then they should have not been influenced by the biasing effects of the hypothesized diagnosis.

<b>Source</b>	<b>Study location</b>	<b>Study population</b>	<b>Main theme</b>	<b>Main measure</b>	<b>Relevant findings</b>
(Dory et al., 2010b)	Netherlands	Postgraduate medical trainees	Knowledge content and diagnostic performance	Written tests containing Extended-matching items (EMIs), where items are grouped by topic	They found that the variance in test performance relating to topic was smaller than the variance related to specific items, which suggests that that case-related knowledge does not seem to be the determining factor for diagnostic success. Their findings suggest that the structure of knowledge and reasoning strategies, especially pattern recognition seem to be the most relevant factors.
(Beisecker et al., 1996)	USA	Senior medical students	Shared decision making	Measuring participants' attitudes about involving either a 25-year-old or a 75-year-old patient in the clinical decision-making by using the Beisecker Locus of Authority: Geriatrics Scale	They found that as medical training increased beyond medical school, participants were more likely to lean towards a physician-only decision making. They also found that in case of older patients, residents were most likely to consider the older patients' opinions, while experts were least likely to do so. Finally, they found that female participants were more likely to consider patient input than male participants.

From the selected 22 articles, 14 involved senior medical students as participants, 7 involved newly qualified doctors, and 1 involved both. Twelve of the studies described their main outcome measure as a questionnaire or survey, 1 involved OSCE scores as performance measure, 4 involved problem-solving exercises based on written scenarios, 1 involved problem-solving based on virtual cases, 3 involved written reflective portfolios based on students' real consultations during their general practice placements, and 1 involved the observation of real general practice consultations assessed against an assessment instrument. From the 22 studies identified in this review, 6 studies were from the USA, 4 from the UK, 2 from Canada, 2 from Sweden, 2 from Slovenia, 1 from Australia, 1 from Belgium, 1 from Poland, 1 from the Netherlands, 1 from Sri Lanka, 1 from Switzerland and Hungary.

The findings of these studies revolved around ten themes: (1) **gaps in medical knowledge**, (2) **cost awareness**, (3) **the influence of general practice placements on diagnostic skills**, (4) **students' perceptions and experiences of primary care consultations**, (5) **the strength and weaknesses of students' consultation skills**, (6) **ethnicity influencing diagnostic performance**, (7) **estimates and certainty judgement**, (8) **direction of the reasoning process**, and (9) **knowledge content and diagnostic performance** (10) and **shared decision making**.

Three studies found that there were gaps in the medical knowledge of senior medical students relating to various topics, which may have a negative influence on their diagnostic skills (Shah, 2001, Esparaz et al., 2014, Rogowska-Szadkowska and Chlabicz, 2010). These studies involved participants from Poland, the USA and the UK, and they found knowledge deficits relating to HIV/AIDS symptoms, ocular conditions, and autism respectively. One study found that Canadian postgraduate trainees had gaps in their knowledge relating to concussion diagnosis and management (Mann et al., 2017). Finally, a study from the USA found that both senior medical students and newly qualified doctors have knowledge deficits relating to the use of blood cultures for diagnostic purposes (Shah, 2001). They also found that these two groups are the most likely to order such tests for diagnostic purposes, which highlights the importance of this knowledge deficit. These studies all indicate that senior medical students and newly graduated doctors have areas of biomedical knowledge deficits that could negatively influence their diagnostic performance.

Two studies from the USA focused on postgraduate medical trainees' awareness of the cost associated with common diagnostic tests and the influence of already invested resources for continued management (Carlson and Dachs, 2015, Bornstein et al., 1999). The first study tested family medicine residents' knowledge about common diagnostic laboratory tests and radiology tests in a primary care setting. They found that family medicine residents were largely unaware of the hospital charges associated with common diagnostic tests. This finding was important due to the increasing pressure towards achieving better cost effectiveness in healthcare in the USA. It is suggested that better cost awareness relating to routine diagnostic tests could influence the diagnostic approach of physicians. The second study looked at whether the amount of resources already invested in the diagnosis and management of the patient would influence the decisions regarding the future treatment of the same patient. They found that internal medicine and family practice residents were not influenced by the amount of time and money already invested in the patient's treatment when making decisions about whether to change their treatment plan. This was interpreted in the study as a case of sound clinical reasoning, because residents would show willingness to switch treatment even if the initial investment into a previous treatment was high. These two studies highlight the importance of being aware of the costs associated with diagnostic tests and at the same time the importance of not being directed by the costs of treatment options when making clinical decisions about management plans.

The next theme explored by three of the studies was how learners rated the contribution of their primary care placements towards their diagnostic skills. Three studies, one from the UK, one from the USA, and one from Sri Lanka, found that senior medical students consider their general practice placements to help improve their diagnostic decision-making skills, their understanding of the psychological and social aspects of illness, their skills relating to differential diagnoses, focused patient evaluation skills, problem solving skills, analytic thinking skills, and history taking skills (Lloyd and Rosenthal, 1992, Schwiebert et al., 2009, Ramanayake et al., 2015). One UK study involving Foundation doctors found that Foundation doctors also consider general practice placements useful and they felt these placements improved their clinical decision-making skills (Walzman et al., 2015). These studies show that both senior medical students and newly graduate trainees value their general practice placements and consider those to have a positive effect on their diagnostic skills.

Two Swedish studies have looked at senior medical students' experiences and perceptions of their general practice consultations (Svenberg et al., 2007, Haffling et al., 2010). The first study was looking at the reflective descriptions of final year medical students of memorable general practice consultations (Svenberg et al., 2007). They found that senior medical students realized that often the presenting complaint of the patient is not the real reason for their GP visit and therefore it is important to explore their background. They found that students showed an understanding that clinical cases are often complex and involve a level of uncertainty that they will need to learn to deal with. Students showed emerging awareness to keep an open mind and try to withhold jumping to diagnostic ideas too soon. Finally, students found their supervisors to be important role-models during this stage of their training when they are attempting to develop their own consultation style. The second Swedish study was also looking at the qualitative analysis of final year students' reflective commentaries upon their general practice consultations (Haffling et al., 2010). In this study, students described time management as one of the main challenges in primary care. Their strategies to deal with this challenge involved setting an agenda for the consultation, keeping the consultations on track, even if that means politely disrupting talkative patients, and finally using frequent summarizing. They recognized the importance of active listening to the patient especially at the start of the consultations, to identify the patient's perspective on their problem and to reach shared understanding with the patient. They further emphasized the important of rapport building and reflected on their improved ability to address sensitive issues as a sign of their professional development. Some students found that they need to further improve their communication skills. Several students reported clinical reasoning to be a problematic area for them. They found it difficult to translate their theoretical skills into clinical practice and they found it difficult to apply their knowledge base for non-specific complaints presented in primary care. Some students mentioned trying to counteract their tendency to jump to conclusions by keeping a broad perspective, while others mentioned trying to consider the most serious and unlikely differentials first in order to prevent errors. Some students doubted their knowledge base, finding it difficult to come up with differentials, and many lacked knowledge for formulating management plans at the beginning of their rotations. These two studies provide an insight into how Swedish, final year medical students perceive and experience general practice consultations.

Three studies looked at the strength and weaknesses of the consultations skills of senior medical students during primary care consultations in Slovenia and the UK (Klemenc-

Ketis and Kersnik, 2014, Hastings et al., 2006, Petek Ster et al., 2014). Two studies were based on data collection in Slovenia, and these studies found that senior medical students were good at the initial assessment of the complaints, but less competent in patient education and patient involvement (Klemenc-Ketis and Kersnik, 2014). They also found that while final year medical students were aware of the patient-centred, holistic management approach in primary care, but they needed further training in problem-solving skills and decision-making processes that are characteristics of primary care physicians (Petek Ster et al., 2014). The third, UK study was based on the observation of final year medical students' general practice consultations (Hastings et al., 2006). As participants were completing the general practice consultations, two assessors were scoring their performance with the aim of identifying the participants' strength and weaknesses with regards to consultation skills. They completed a total of 1116 assessments between 1998 and 2004 and found a considerable heterogeneity in students' consultations skills. They reported that the most frequently identified strength of the students was their interpersonal skills of rapport building and attentive listening to the patients' problems. The key weakness of the students was diagnostic problem-solving, involving generating appropriate differentials and collecting relevant information during history taking, highlighting the need for further training in these domains.

One Australian study focused on the factors influencing diagnostic performance among senior medical students (Petek Ster et al., 2014). The participants' final-year performance was obtained through university records of the students' OSCE scores and General Practice exam scores which were also characterized by an OSCE format. They found significant differences in performance based on the ethnicity of the participants. They found that students of Non-Western ethnic background performing consistently poorer in all assessment parameters than Western born students. The authors proposed that these findings may be explained by examiner bias and discrimination during examinations or communicational difficulties experienced by non-Western students.

Two studies looked at estimates and certainty judgement in primary care consultations (Vajer et al., 2010, Dory et al., 2010a). In a cross-sectional, questionnaire-based study conducted in Hungary and Switzerland, they found that medical students and residents estimated the risk of both COPD and congestive heart disease lower than experts in primary care setting (Vajer et al., 2010). They found no significant difference between the scores between the two countries. Finally, they found that female residents gave

higher risk rating than male residents. The second study was based in Belgium and used written multiple-choice question (MCQ) test followed by a degree of certainty judgement to investigate the metacognitive skills of postgraduate GP trainees (Dory et al., 2010a). They found that a third of participants showed partial knowledge, suggested by mistakes on the MCQ tests. A sixth of participants showed signs of hazardous ignorance, which meant they gave the wrong answer for the MCQ tests and rated that answer with high level of certainty. These findings suggest that introducing a certainty measure for MCQ tests may be important to detect hazardous ignorance in medical trainees.

One study explored the direction of reasoning of postgraduate trainees in primary care (Leblanc et al., 2002). In this Canadian study, they compared how the diagnostic hypothesis influences the interpretation of clinical features among second year medical students and residents. They presented participants with written case histories and patient photographs together with a tentative diagnosis, in order to test the influence of the tentative diagnosis on their diagnostic reasoning. They found that both second year medical students and residents were equally susceptible to the biasing effect of the suggested diagnosis. These findings seem to contradict the claim that clinical reasoning development involves an increasing use of forward reasoning and less backward reasoning. The authors explained that if residents were using more forward reasoning than novice medical students, then they should have not been influenced by the biasing effects of the tentative diagnosis. Their study suggests that it is more likely that both medical students and residents generate differentials early on and proceed with a hypothesis testing approach.

One Dutch study looked at the relationship between content knowledge and diagnostic performance among postgraduate trainees (Dory et al., 2010b). They used Extended-matching items, where tasks are grouped according to topic, and each topic includes several items. Researchers found that there was a larger variance in performance among items than among topics. Therefore, the researchers concluded that case-related knowledge does not seem to be the determining factor for diagnostic success. Their findings suggest that the structure of knowledge and reasoning strategies, especially pattern recognition seem to be the most relevant factors.

Finally, one early study from the USA looked at the concept of shared decision making in primary care (Beisecker et al., 1996). They investigated how the level of training

influences the physicians' attitude towards taking into account the patients' beliefs during clinical decision making. They involved first- and third-year medical students, family practice and internal medicine residents, and experts. Their attitudes were assessed based on written clinical case scenarios. They found that as medical training increased beyond medical school, participants were more likely to lean towards a physician-only decision making. They also found that in case of older patients, residents were most likely to consider their opinions, while experts were least likely to do so. Finally, they found that female participants were more likely to consider patient input than male participants.

It is evident from this literature review that there is a scarcity of studies looking at the diagnostic skills of senior medical students and early postgraduate trainees in primary care setting. The findings presented here have limited explanatory power and only cover a few aspects of diagnostic reasoning. The considerable heterogeneity in the location of the studies makes generalizability problematic due to the differences in the curricular structure among these countries. The heterogeneity of research methods is another obstacle for drawing generalizable conclusions. The majority of studies used a written-case-based tests or questionnaire to evaluate the diagnostic skills of their participants. While these studies can provide interesting insight into various domains of diagnostic competence, they fail to consider the contextual factors that can affect the cognitive processes of participants in real clinical environments. In this review, the studies based on real consultations or the written account of real consultations could provide the closest approximation of what characterizes the actual thinking process of medical trainees in a primary care environment. From those four studies, only one involved medical students from the UK. This study by Hastings et al (2006) involved the direct observation of medical students completing diagnostic general practice consultations. Their study provides important insight into the competencies of final year medical students in the UK. However, from a diagnostic reasoning perspective, the weakness of the study lies in its observational nature. The assessment of the students was reliant on the students' overt behaviours during the consultations, which may or may not directly correlate to their cognitive content. In order to explore the diagnostic reasoning process of medical trainees, researchers need to utilize techniques that allow the student to verbalize every aspect of their thinking process. This type of introspective narration could reveal the diagnostic reasoning process of the participants.

## 2.4 USING SIMULATION TO EXPLORE DIAGNOSTIC REASONING SKILLS

When studying a cognitive process in a real environment is problematic or restricted, simulation can be a suitable alternative to study those cognitive processes in a contextualized way. In order to find out whether and how primary care simulation has been utilized to explore diagnostic reasoning in medical education, a literature search was conducted using the following search terms: ("primary care" or "general practice") AND ("medical students" or "medical curriculum" or "medical education") AND ("simulated patients" or "simulated practice" or "simulation" or "standardized patients") (See *Table 4*). The databases in the ProQuest search included MEDLINE, PsycARTICLES, and ProQuest Dissertations & Theses Global. An EBSCOhost literature search was also conducted with the same parameters involving the PsycINFO, Cumulative Index to Nursing and Allied Health Literature, Educational Resources Information Center, British Education Index databases.

**Table 4:** Literature review key words focusing on the use of simulation to explore diagnostic skills in medical education relating to clinical problems that are relevant to a primary care setting

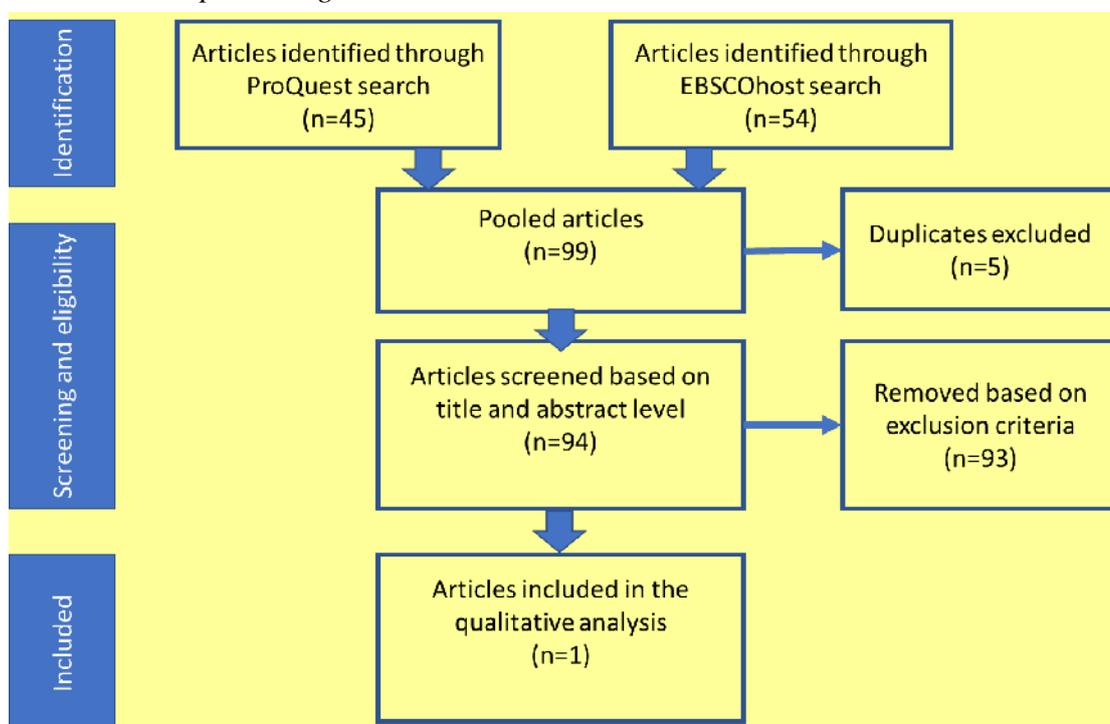
primary care OR general practice	AND	medical students OR medical curriculum OR medical education	AND	simulated patients OR simulated practice OR simulation OR standardized patients OR virtual patients
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The terms medical students, medical curriculum, medical education, simulated patients, simulated practice, simulation, standardized patients were restricted to abstract level, while the terms primary care and general practice were searched in full text articles. Due to the heterogeneity of terms used to describe diagnostic reasoning in various articles, this search did not involve the diagnostic reasoning dimension in order not to restrict the results. Instead, articles were judged individually to decide whether they involved an element of diagnostic reasoning later on during the review process.

The initial ProQuest search identified 45 peer-reviewed, English language articles on this topic, while the EBSCOhost search identified 54 articles as well. From these 99 articles in total, 5 were duplicates, which were removed. The resulting 94 articles were pooled and review on abstract and title level. Based on their titles and abstract, a further 35 were excluded because they did not involve relevant, primary data collection, 31

were removed because they did not involve an element of diagnostic reasoning, and 4 were removed because they focused on a secondary care setting. Full-text versions of the remaining 24 articles were retrieved. From these articles, a further 11 were excluded as they involved the evaluation of an intervention or assessment tool. Finally, the last criteria to test the remaining 13 articles was regarding the participants involved in the study. The present review was interested in research based on senior medical students who were at a maximum of two years prior to their graduation, or postgraduate trainees within 2 years of their graduation. After applying these criteria, only one relevant article remained. The literature search process is summarized on *Figure 6*.

**Figure 6:** *The screening process for the literature review focusing on the use of simulation to explore diagnostic skills in medical education*



The only relevant article described a Norwegian study by Gude et al. (2013). The study investigated final year medical students' performance during diagnostic consultations with standardized patients (Gude et al., 2013). Participants were instructed to conduct diagnostic consultations as if they were trainee GPs in a general practice setting. They had 15 minutes to complete the consultations. Participants were invited back 18 months later to conduct a similar consultation again. They found a positive correlation between consultation length and the amount of information obtained during the consultations, especially psychosocial information. This correlation got stronger for the follow-up

study. These findings highlight the importance of consultation length in senior medical students and junior doctors.

This literature search clearly indicates the scarcity of studies used to explore the diagnostic reasoning process of senior medical students in simulated primary care settings. However, considering the wide spread use of simulation in medical education, it is important to examine how learners think during simulated consultations. Also, the previous literature review revealed that both undergraduate and postgraduate students find primary care placements useful for their diagnostic skill development, which suggests that a learning environment that shares the characteristics of primary care consultations, such as primary care simulations, may also be beneficial for students. Finally, simulated scenarios allow educators to pause and rewind scenarios, which would facilitate the integration of diagnostic reasoning training through such simulations. Exploring how medicals students think during simulated primary care consultations could help develop and refine such educational strategies.

In light of these literature reviews, the present study added to the existing literature by exploring the diagnostic reasoning process of senior medical students and Foundation trainees in simulated and real primary care settings. The present study is the first of its kind to explore medical students' perceptions and experiences of their own diagnostic reasoning process during simulated and real primary care consultations, utilising video-stimulated, retrospective think-aloud procedure (See in Chapter 3). The present study not only provides an account of how medical trainees think during diagnostic primary care consultations, but also of how they perceive and interpret their own diagnostic approach.

#### 3.1 INTRODUCTION

Chapter 3 outlines the research methodology of the present study. It starts by outlining the theoretical framework of critical realism, its ontological and epistemological assumptions, and its suitability for studying diagnostic reasoning. It then proceeds to discuss the characteristics of mixed-method research and how it applies to the present study. Next, the main data analytic method, **Interpretative Phenomenological Analysis** (IPA) is described. IPA is a qualitative research method used for the in-depth exploration of lived experiences by combining phenomenological and hermeneutical philosophies. The notion of reflexivity is highly relevant for IPA research and is therefore discussed here. Finally, triangulation and its application in the present study is explained.

Once the theoretical underpinnings of the study are explained, the research problem and research questions are outlined. The main research objective of the present study was to explore the diagnostic reasoning experiences of three groups of medical trainees in different settings:

- Year 4 medical students in a simulated GP surgery setting consulting with standardized patients
- Year 5 medical students in a GP practice setting consulting with real patients
- Foundation doctors (FY2) in a GP practice setting consulting with real patients

The research questions of the study focus on the participants' thoughts, perceptions and experiences of diagnostic consultations, which justifies for the predominantly qualitative research design.

### 3.2 THEORETICAL FRAMEWORK: CRITICAL REALISM

Whilst all research fundamentally aims at increasing the understanding of the world, various research paradigms adopt different ontological and epistemological positions to guide their research process. *Ontology* refers to the study of existence and it is concerned with what constitutes as reality, while *epistemology* refers to the study of knowledge and what constitutes as knowledge (Cleland and Durning, 2015). There has also been an essential distinction made between quantitative and qualitative research approaches. Quantitative approaches are characterized by using standardized measures and statistical techniques in line with positivist ontology (McEvoy and Richards, 2006). Positivist ontology assumes that there exists an absolute truth and it is the researcher's task to find it. As truth is objective and independent of the researcher's knowledge and experience, it can be measured by choosing the appropriate research methods, such as questionnaires, randomized control trials and structured interviews. On the other hand, qualitative studies tend to aim at an in-depth understanding of the phenomenon by utilizing interviews and focus groups, which is more consistent with an interpretivist approach. These types of studies often use a relativist ontology, which acknowledges the complexity of social processes and the importance of contextual factors. Relativist ontology takes into account interpretation, motivations and values of individuals and their ability to influence the social world. Relativism relies on the notions that: there is no absolute reality, and everything is relative to its particular context.

Due to these differences in their underlying ontological and epistemological assumptions, there has been a long-standing debate between the advocates of each position, and whether the two approaches should ever be combined within one research study or whether the differences between the two are just too great to ever be reconciled (Tashakkori and Teddlie, 1998, Guba and Lincoln, 1989, Bryman, 2004, Creswell et al., 2004).

One such theoretical framework which offers a solution to this problem is critical realism. Critical realism suggests that researchers should go beyond the research questions to identify the broader research problem as the centre of their research. Critical realism assumes that the understanding of the research problem can be most complete by combining various research strategies, as those will shed light to different aspects of the research problem. It assumes that in a study, first the problem area is identified, which leads to the development of philosophical assumptions, which then

leads onto the formulation of more specific research questions that eventually leads to the selection of appropriate research methods (Edgley et al., 2014).

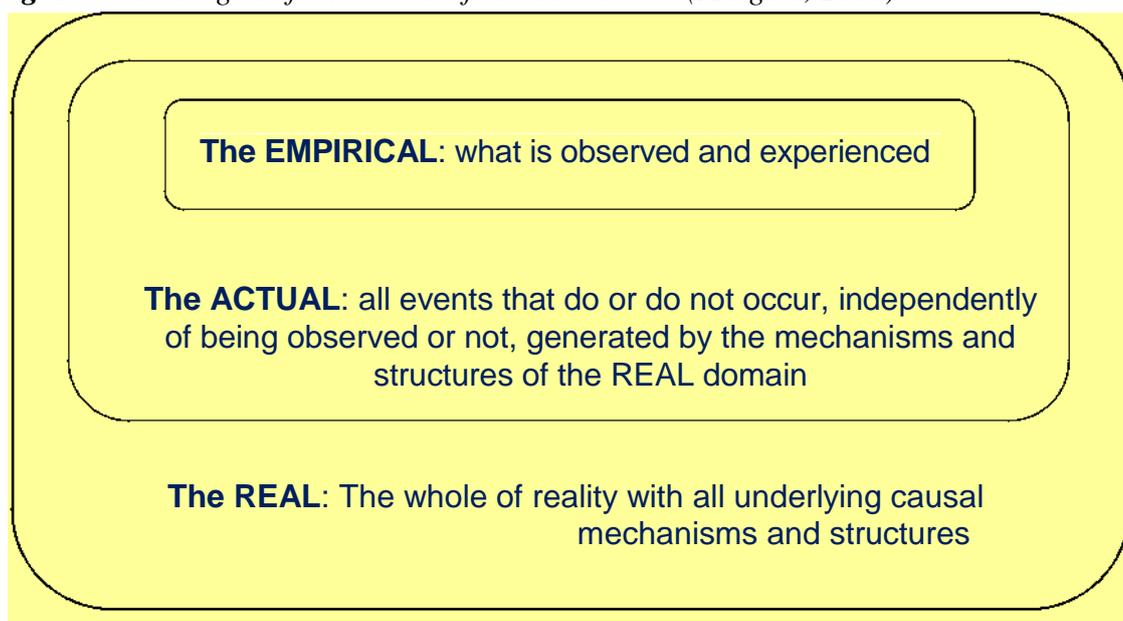
The theoretical framework of critical realism was first introduced by the British philosopher, Roy Bhaskar (Bhaskar and R., 1975, Bhaskar and R., 1978, Bhaskar and R., 1989, Bhaskar and R., 1998) . Unlike the pragmatist position, critical realism does not ignore the importance of the relationship between ontology, epistemology and methodology in research. It accepts that the explanatory power of a study is enhanced when its ontological, epistemological and methodological approach is clearly articulated as maintaining these assumptions throughout the reasoning of the study ensures the coherence of its arguments (Danermark et al., 2002, Bergene, 2007, Lipscomb, 2008). Accordingly, critical realism makes claims about both ontology and epistemology.

Critical realism combines the principles of two separate philosophies: it derives its ontological assumptions from critical naturalism, while the epistemological assumptions originate from transcendental realism. *Critical naturalism* is a philosophy of social sciences that holds a middle ground between positivism and interpretivism (Zachariadis et al., 2013). Positivists, such as Habermas (1978) and Giddens (1976), suggest that reality is objective and independent of human beings and by carefully designed experiments, researchers can access that reality and identify laws and regularities (Mingers, 2014, Habermas, 1978, Giddens, 1976). Interpretivists, such as Schutz (1972) and Gergen (1999), on the other hand state that the social world is inherently different from the natural world, and claim a basic ontological difference between natural and social events (Schutz, 1972, Gergen, 1999, Mingers, 2014). They emphasize that social events are created through language and meaning and thus require a different methodological approach. They also assume that facts and observations of social events can never be independent of the observer's social and cultural background (Saunders, 2009). Critical realism assumes that there are both similarities and differences between the natural and the social world. It points out that both positions share a focus on the empirical, aspects of the world that are perceptually available. As opposed to the interpretivists, critical realism accepts there exists a reality is independent of our knowledge or perception of it, arguing for an ontological realist view (Zachariadis et al., 2013). Critical realism states that there is an independently existing world of mechanisms and structures that cause events that occur or do not occur, however, only part of this world can be observed and experienced directly.

At the same time, critical realism accepts that knowledge and observations will always be influenced by the social and cultural background of the individual and hence never be pure and unmediated, arguing for an epistemological relativism (Mingers, 2006). These assumptions are derived from *transcendental realism*, a philosophy of science based on Kant's '*Critique of pure reason*', which claims that knowledge is acquired based on empirical observations, while acknowledging that such knowledge is imperfect and can change over time (Zachariadis et al., 2013).

Critical realism assumes that there are three domains of reality that researchers need to be aware of: the empirical domain, the actual domain and the real domain (See *Figure 7*). The *empirical domain* refers to those events and aspects of reality that can be directly observed or experienced by individuals. Critical realism states that these events are only a small subset of all the events that occur in the world. In line with realist ontology, critical realism also argues for the existence of a reality independent of human perception. The *actual domain* refers to all the events and aspects of reality that exist but might not be observed or experienced by individuals. While many of these events never reach the empirical domain, they occur independently of our perceptions. Finally, the *real domain* refers to those aspects of reality that cause or influence what is observed or experienced. While these real structures and mechanisms cannot be directly observed or experienced, they can be inferred from the empirical domain by inductive (theory construction) or deductive strategies (theory testing) (McEvoy and Richards, 2006). Critical realism positions the research problem in the real domain, and criticises positivist views for reducing events to empirical experiences and basing laws on observable events, hence restricting the research problem to the empirical domain. Critical realism emphasizes the importance of exploring phenomena, which are not directly observable, and urges researchers to examine the theories, interpretations and meanings in their research area in order to be able to move beyond the empirical domain of reality (Edgley et al., 2014).

**Figure 7:** *Ontological foundations of critical realism (Mingers, 2006).*



Finally, retrodution is an important element of the critical realist approach. It refers to the analytic process of data in the late stages of the study that cultivates theoretical model building. The model building process progresses from observed empirical trends (so called demi-regularities), towards explaining causal mechanism and structures of the real domain. The aim of retrodution is to identify the social, psychological and contextual conditions under which the particular mechanisms take place and that results in the observable trends. According to Fletcher (2017), “*the key outcome of successful retrodution is to modify, support, or reject existing theories to provide the most accurate explanation of reality*” (Fletcher, 2017). Retrodution allows the development of a model that provides a possible mechanism and structure for what is observed and experienced – it proposes that if those mechanisms existed, they would produce the observed behaviours and experiences (Mingers, 2006). However, the model itself should not be taken as undisputable proof for the existence of those proposed mechanisms and structures. Retrodution needs to be followed by the process of elimination whereby competing explanations are gradually eliminated through further research which in turn could lend further support for the model proposed (Mingers, 2006). This emphasizes the need for future studies to test the model proposed in the present study.

The present study investigated medical trainees’ diagnostic reasoning skills through their lived experiences of simulated and real diagnostic consultations. The principles of critical realism are especially suitable for the study of diagnostic reasoning. Diagnostic

consultations in real clinical practice are situated in the social world and always involve an interactive, social element. From a critical realist view, the social world can be defined as an ‘*open system*’ (Bhaskar, 1978). In an open system, one can never precisely predict the future due to the complexity and uncertainty of the interactions between the components of the system. In such open systems, one cannot state that A, acting on B will always result in C, because the same underlying causal mechanisms and structures can lead to different outcomes (Edgley et al., 2014). Durning et al., (2010) proposed that chaos theory and quantum physics can provide useful theoretical lenses to view and understand such systems and mechanisms (Durning et al., 2010). *Chaos theory* argues that even though the outcome of an event in an open system is bounded by its initial conditions, the precise outcomes of the event cannot be predicted at the onset, due to the complex interactions between the components of the system (Gleick, 1988, Smith and Thelen, 2003, Eva et al., 1997). The *Heisenberg uncertainty principle* of quantum physics also states that while it is possible to know the starting point and the desired end point of the event, predicting exactly what is happening at any given time between those two points is impossible (Pais, 1991). In terms of diagnostic consultations, it is possible to define the starting point of the consultation, such as the presenting complaint of the patients and it is also possible to define the desirable outcome of the consultation, such as arriving at a diagnosis or management plan, however, it is impossible to predict the exact course of events within the consultations (Edgley et al., 2014). It is not possible to predict the exact cognitions and behaviours of the physician at any given point of time during the consultation, because events do not happen the same way in every consultation due to the complex interactions between the physician, the patient and the clinical environment (Edgley et al., 2014). Therefore, the theoretical framework of the research of such social cognitive processes need to take into account these principles. Studies that investigate social cognitive processes through context-free, experimental procedures often attempt to eliminate confounding variables in order to reduce the process into artificially created ‘closed system’ (Rolfe, 1999, Fleetwood, 2017). In closed systems, the same cause will always lead to the same outcome. However, such reductionist approach ignores the inherent complexities of the social world and therefore their findings may not transfer well into practices of the real clinical world. For these reasons, the present study took a critical realist position, in order to allow for the contextual exploration of the diagnostic reasoning process.

In line with the epistemological and ontological principles of critical realism, the present study moves beyond the empirical domain of reality, the observed behaviour, to

explore the meanings and interpretations participants attribute to the diagnostic process in primary care. The interpretative elements of the data analytic process explore and attempt to discover the actual and real domains of diagnostic reasoning. In line with the critical realism view, the study achieved retrodution by contextualizing the findings and developing new theoretical explanations based on the empirical evidence.

### **3.3 MIXED METHOD RESEARCH**

The use of mixed-method design is consistent with the critical realist approach, which states that using multiple methodological or philosophical perspective can be justified as the combination of those methods and perspective could help fully explore the phenomenon of interest. Mixed method approaches therefore tend to combine qualitative and quantitative methods in a single study to obtain a holistic understanding. Mixed method studies have been widely used and advocated in the field of social and healthcare research (Collins et al., 2007, Weller and Dungy, 1986, Miller, 1997, Chavez et al., 1995, Pedersen et al., 2008). However, in the field of medical education, there is an inherent receptiveness towards predominantly quantitative approaches as those are more in line with traditional approaches of biomedical research, which guides much of the medical field and medical curricula (Buckley, 1998). Nevertheless, there is a growing consensus that mixed method studies could make valuable contribution to the field of medical education (Bordage, 2007a, Buckley, 1998, Kuper et al., 2007, Schifferdecker and Reed, 2009). It has been proposed that studies which combine quantitative and qualitative elements could increase both the integrity and the applicability of the findings when studying complex phenomenon, and therefore there is a need for an increased presence and recognition of this approach (Schifferdecker and Reed, 2009). In line with this recommendation, the past decade has seen a growth in the number of mixed method studies in the medical education literature (Schifferdecker and Reed, 2009).

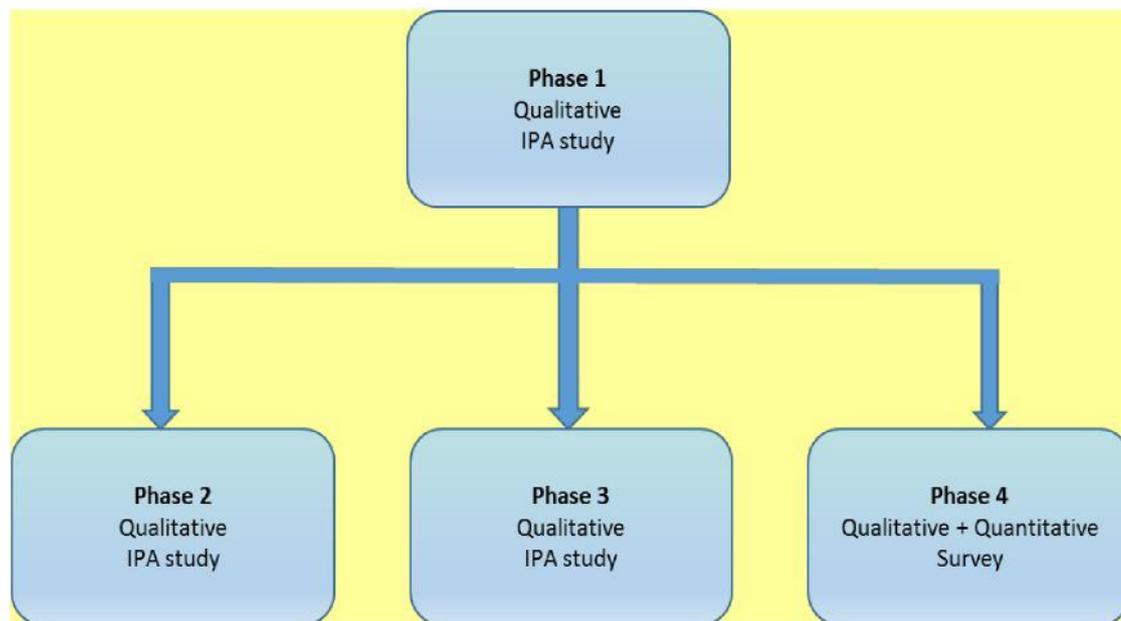
Mixed method studies can use various research designs based on the research question. There are four main characteristics that may be used to define the design of a mixed method study (Creswell):

- 1) Implementation
- 2) Priority
- 3) Integration
- 4) Theoretical perspective.

Implementation refers to the sequence of qualitative and quantitative elements in the study (Creswell et al., 2004). Implementation can take place concurrently, when the qualitative and quantitative information is gathered simultaneously, or sequentially, when the data collection phases follow one another. In the present study the aim was to explore the phenomenon under study, and then follow up on this exploration by further data collection phases. The study was initially a sequential design where a qualitative

phase was followed by three further phases. The latter three phases took on a concurrent design, where data were collected simultaneously (See *Figure 8*).

**Figure 8:** *The mixed-method design of the present study*



The priority in the present study was placed on the qualitative elements of the study. Flowers and Larkin (2009) emphasised that when using IPA for mixed method approach, the qualitative element should receive at least as much importance as the quantitative element. In the present study the qualitative elements played the primary role in the research design, because the primary aim of the study was to explore the participants' lived experiences of diagnostic consultations, which can best be achieved by giving them space to express and describe those experiences in detail through qualitative data research methods. The quantitative element had a supplementary role of extending and supporting the qualitative findings.

The integration of the data from the qualitative and quantitative elements takes place at two separate time points, at data collection in Phase 4 and at the final interpretation phase. In phase 4 of the study, a questionnaire with both open-ended and Likert-scale type questions was administered. The use of both quantitative and qualitative data collection at this phase was the first point of integration. The second integration point was at the final interpretation phase, presented in Chapter 6.

Finally, the theoretical perspective taken was critical realism, as outlined previously in this chapter. The aim of using this perspective was to use multiple research methods to achieve a more complete understanding of the phenomenon under investigation. In the present study, both the qualitative and quantitative elements aim at contributing to a better understanding of the diagnostic reasoning skills of senior medical students and foundation trainees in a primary care setting. The qualitative elements explored the participants' lived experiences of simulated and real primary care consultations. The participants' lived experiences of the consultations provided access to the empirical domain of reality. The interpretative elements on the other hand provided insight into the actual and real domains. The quantitative parts of the study were also used to explore the experiences of the medical students in the empirical domain. They built on the findings of the qualitative parts of the project, and aimed to explore the frequency of occurrence of those experiences in a wider sample of participants and extending it to the year group of final year students.

### **3.4 INTERPRETATIVE PHENOMENOLOGICAL ANALYSIS (IPA)**

The main research strategy in the present study was Interpretative phenomenological analysis (IPA). IPA is a qualitative research approach that aims to offer insights into how people in a defined context make sense of a certain phenomenon (Chan et al., 2010, Smith et al., 2009). Instead of a predetermined research hypothesis, this approach starts off with a broad, general research question and aims to explore how the participants make sense of their lived experiences (Langdrige, 2007).

While IPA shares many similarities with other qualitative data analytic methods, such as Grounded Theory and Discourse Analysis, they also exhibit some key differences. IPA studies aim to understand a phenomenon, which can only be understood through in-depth interviews with individuals who have first-person experiences of that relevant phenomenon. IPA research solely relies on participants who lived through the events relevant for the study and analyses their lived experiences. Grounded theorists on the other hand seek to include all data sources that could be relevant in developing a theory of the phenomenon of interest (Gerrish, 2010). The sampling procedures also differ in IPA and Grounded theory. IPA aims to select a small, homogenous sample of individuals, while Grounded theory approach benefits most from a larger, heterogenous participant group (Smith et al., 2009, Corbin, 2008). In Grounded Theory, researchers use a systematic, constant comparison analysis through theoretical sampling, whereby data is collected and analysed simultaneously, and data collection continues until theoretical saturation is reached (Corbin, 2008). Theoretical saturation refers to the state when no new insight is emerging from the data and the theoretical model is complete and fully explained (Lewis-Beck et al., 2004). In the present study, due to the difficulties of participant recruitment, such theoretical sampling would not have been possible.

IPA is also different from Discourse Analysis and other semiotic approaches in that the main focus of Discourse Analysis is the written, vocal, or sign language use of participants and how the use of such language can convey meaning in particular contexts (Patton, 2002). While IPA also has an element of linguistic interpretation, Discourse Analysis approaches tend to focus on the constructive and functional role of language (Wetherell et al., 2001, Potter and Wetherell, 1987). IPA looks the choice of words and expressions of participants from an interpretative perspective, and in addition to the linguistic element, it also involves conceptual interpretations of meanings and

identities. In order to study diagnostic reasoning, it is important to consider how participants make sense of the diagnostic process and how they interpret their experiences, and therefore it is argued that IPA is a more suitable approach than semiotics.

The three main theoretical underpinnings of IPA are (1) phenomenology, (2) hermeneutics, and (3) idiography (Smith et al., 2009).

### *1. Phenomenology*

Phenomenology is a study of lived experience, also referred to as the life world of individuals (van Manen, 1997, Smith et al., 2009). It is an approach that aims to understand and explore the lived experiences of individuals and identify things that matter to them (Smith, et al., 2009, pp.11.). Leading figures in phenomenological philosophy include Husserl, Heidegger, Merleau-Ponty and Gadamer (Smith et al., 2009). Edmund Husserl (1859-1838), the founder of modern phenomenology, has argued for the careful examination of human experiences (Husserl, 1927). He was interested in the experiential content of consciousness to understand the universal essence of a given phenomenon (Larking and Thompson, 2012, Smith et al., 2009, Larsson and Holmström, 2007). Importantly, Husserl was interested in going beyond the natural perception of everyday experiences (Smith et al., 2009). He wanted people to adopt a phenomenological attitude, whereby people stop and reflect on the phenomenon of interest in order to rise above their everyday assumptions (Larking and Thompson, 2012, Smith et al., 2009). Husserl also emphasized the importance of bracketing, which refers to suspending all pre-existing assumptions in order to find the true nature of the phenomenon. His phenomenological approach is also known as transcendental phenomenology, which is predominantly descriptive in nature, and positivist in ontology. Husserl's successors, Heidegger (1889-1976), Merleau-Ponty, and Gadamer (1900-2002) on the other hand acknowledged the fact that true bracketing is not possible and the researcher will always have some pre-existing knowledge and assumptions about the phenomenon in question (Smith et al., 2009). Their approach has given rise to a new philosophical movement in phenomenology, known as hermeneutic phenomenological approach, which paved the way for research methods such as IPA.

## *2. Hermeneutic*

Hermeneutics is the theory of interpretation. Originally hermeneutics was concerned mainly with providing interpretations for biblical texts (Smith et al., 2009). It acknowledged that texts are not intrinsically meaningful, rather it is the interpreter who attributed meaning to them. It claims a certain singularity to both the participant experiencing the phenomenon and the researcher interpreting the experience (Ricoeur, 1970). The combination of hermeneutic theory and phenomenologist led to the creation of new philosophical directions such as hermeneutic phenomenology and phenomenological hermeneutics. Both of these philosophies stress the importance of the hermeneutic cycle and aim to achieve an understanding of the essence of certain phenomena. The difference between them lies in their focus and what they attribute more importance to, phenomenology or hermeneutics. IPA as a qualitative research analysis method has originated from these philosophical traditions.

IPA aims to help understand how individuals make sense of their lived experiences and therefore places emphasize on the individuals' interpretation of lived experiences. Furthermore, IPA goes beyond the single level of interpretation and aims at achieving a double hermeneutic (Smith and Osborn, 2003). First, it utilizes the participant's own interpretation of their lived experience. Second, it incorporates the researcher's interpretation of the participant's interpretation. According to Smith, Flowers and Larkin (2009), during the IPA process, these secondary interpretations should be prompted by and grounded in the empirical data (Smith, et al., 2009, pp.186)

## *3. Idiography*

The third main theoretical influence of IPA is idiography. As opposed to other methodologies which aim to claim general rules of human behaviour, IPA is concerned with the particular instances of lived experience (Smith, et al., 2009, pp.29). This focus on the particular has two levels. First, IPA is committed to detail, and hence is reliant on a deep level of thorough analysis (Smith et al., 2009). Second, IPA is focused on how certain people experience a certain phenomenon in a certain setting (Smith et al., 2009). Hence IPA tends to use small, purposefully selected samples (Smith et al., 2009). The analysis often moves from single case studies towards more general claims (Smith et al., 2009). As such, it does not try to avoid generalizations, it just approached it from a different perspective: instead of basing them on what is shared within large samples, it builds on what is found in the particular (Smith et al., 2009, Harre, 1979). However, the focus on the particular, and the singularity of the hermeneutic tradition also means that

there is no right or wrong answers, interpretations or explanations in IPA (Smith, et al., 2009, pp.29).

### **3.4.1 Reflexivity**

The notion of reflexivity is an integral part of IPA. As both the researcher and the participant in a research project are living, experiencing agents, it is important to explore how various stages of the research process can be influenced by the individuals themselves (Shaw, 2010). One way to gain better understanding of the meaning and value of reflexivity is to draw a distinction between reflection and reflexivity. According to Woolgar (1988), reflection is a form of *benign introspection*, whereby the individual tries to access their own cognitive processes and cognitive content (Woolgar, 1988). Reflection focuses on reporting the participant's reality, and it aims to achieve an accurate account of the participant's experience (Shaw, 2010). Its focus on the accuracy of recall positions it to the positivist ontology whereby the participant can provide access to an objective reality as long as they make sure to maximize the accuracy of the reflection. Reflexivity, on the other hand, involves more than just reflection. Reflexivity means that the participant will reflect on the thinking process itself and actively evaluate the experience and the self, and thereby adding an interpretative element to the process (Shaw, 2010). Reflexivity is required from both the participant and the researcher in IPA.

During the interview process, the participants are asked to engage in reflection about their experience and their cognitive content during the experience. Smith, Flowers and Larkin (2009) described four layers of reflection that the participant may engage in during the interview process and during the experience itself:

- 1) Pre-reflective reflexivity
- 2) The reflective glancing at pre-reflective experience
- 3) Attentive reflection on the pre-reflective
- 4) Deliberate controlled reflection

The first three steps are part of the 'natural' reflection of everyday life that the participants are likely to engage with during the actual event. Pre-reflective reflexivity refers to the most immediate flow of experience that barely reaches the threshold of conscious awareness (Smith et al., 2009). It refers to a minimal level of awareness that individuals may experience about where they are and what is going on around them. It

involves experiences that they are minimally conscious of, while not consciously attending to them. The reflective glancing involves an undirected, intuitive reflection upon these pre-reflective experiences that can temporarily increase the level of awareness associated with those pre-reflective experiences. When an experience is registered as significant for the individual, and that requires attention, attentive reflection will be directed to that experience. Through attentive reflection the individual starts to consciously think about that experience. These three levels of reflection occur naturally during any event. Phenomenological studies are interested in a deeper level of reflection, called deliberate reflection. Deliberate reflection means actively and purposefully reflecting on a chosen event and replaying that event in order to provide an account of the experience of interest. This phenomenological reflection is what participants are asked to engage in during the video-stimulated interviews of the present study. However, this is only the first step. During the interview with the researcher they are not only asked to reflect about their experiences, but also to make sense of that experience. They are asked to talk about how they interpret their experiences and to think about what those experiences meant for them. This adds the hermeneutic element to the research process and transforms the reflection into reflexivity.

The participants are not the only ones in an IPA study to engage in reflexivity. It is advised that during the initial phases of the IPA process, the researcher also reflects on their own experience of the research process and analyses how their previous experiences, knowledge, and attitudes may influence the research process (Pietkiewicz and Smith, 2012). One thing to consider is how the personal characteristics of the researcher will affect the rapport with the participants and the data collection in general (Pietkiewicz and Smith, 2012). The author had no prior connection with the medical school or medical education in general. One advantage of not being a member of the teaching faculty seemed to be that students did not perceive the researcher as an authority figure, which was likely to facilitate the disclosure of information students may have otherwise withheld from faculty members. As the data demonstrated, they displayed a strong desirability bias during the simulated consultations, however, the fact that they explicitly pointed this out to could suggest that they did not perceive similar pressure towards the researcher. This provided great opportunity to access their experiences in a more authentic fashion.

Another thing to consider was that the author had personal experience with being a novice diagnostician in the field of clinical psychology and being faced with the challenges of applying diagnostic rules learned in the classroom in real clinical environments. Having been through such experiences made it easier to build rapport with participants as the researcher was able to empathise with the difficulty of the task the participants were experiencing. On the other hand, these personal experiences may have predisposed the researcher towards looking for experiences and interpretations similar to their own. However, at the time when the researcher was going through these “shock of the practice” experiences, she did not engage in reflexivity about those events. The only interpretation brought forward from those experiences was that it is challenging to transition into real clinical practice and taking on the role of a clinician. There were no elaborate interpretations that guided or influenced the researcher based on her own past experiences, instead it was the interpretations of the participants in the present study that helped the researcher interpret her own past experiences.

Another important aspect of reflexivity is how the academic background of the researcher could influence the interpretative aspects of the data analytic process. The researcher had a background in cognitive and clinical psychology, which allowed her to immerse herself in the data from a cognitive psychology perspective. During the analysis, the researcher was actively searching for cognitive features and factors that relate to the participants’ experiences of the diagnostic consultations. The supervisor of the study on the other hand had extensive experiences in the fields of general practice, medical education and diagnostic reasoning. These professional experiences helped to complement the researchers’ views. The supervisors also acted as a critical mirror for the researcher, constantly checking whether the interpretations were solidly grounded in empirical data.

### **3.4.2 Critique of IPA**

While IPA has been widely used over the past decades, there also has been some critique that has been raised, highlighting its potential limitations. First of all, it has been argued, that the experiences that participants are describing in IPA are constrained by language (Willig, 2009, pp 66-68). Willig suggested that the complex processes of thoughts and emotions cannot be described accurately, especially if the participants are not used to describing such processes (Willig, 2009). Therefore, having to rely on the use of language may not allow individuals to share every intricate detail of their

experiences and their understanding of those experiences (Jaeger and Rosnow, 1988). Smith et al (2009) also stated that people's interpretation of their experiences is shaped and possibly limited by the use of language (Smith et al., 2009).

Another related criticism from the semiotic tradition is that the descriptive role of language assumed in IPA may go beyond this role, and actually take on a constructive function (Willig, 2009). It is argued that IPA can only discover how individuals construct their reality, instead of understanding that reality itself (Willig, 2009).

These points of criticisms are not limited to IPA research, instead they seem to apply to most research methodologies that rely on the verbal account of its participants. However, Smith and Osborn (2003) argue that the way people talk about their experiences directly relate to their thoughts and feelings about those experiences (Smith and Osborn, 2003). Therefore, while the criticisms raised by Willig (2009) are acknowledged in the present study, it has been decided that the advantages of the IPA method far outweigh its limitations and it was a suitable method for the present study to explore the research problem and address the research questions.

### 3.5 TRIANGULATION

The final notion that needs to be discussed is the concept of triangulation. Bryman and Bell define triangulation as the use of 'more than one method or source of data in the study of a social phenomena' (Bryman and Bell, 2003). Risjord et al. (2002) describes three main reasons for triangulation: **confirmation, completeness and 'abductive inspiration' or retroduction** (Risjord et al., 2002, Risjord et al., 2001). The theoretical framework and the main research analytic method of the present study are most compatible with the completeness and retroduction arguments for triangulation. Both critical realism and the philosophical underpinnings of Interpretative Phenomenological analysis share the assumption that researchers are always influenced by their knowledge and experiences. Even though there is a tangible, objective reality, different researchers may perceive events differently and may draw different interpretations about the underlying structured and mechanisms causing those events. Different research methods can also explore different aspects of the reality, instead of confirming or disproving each other. Completeness and retroduction on the other hand, are both compatible purposes for triangulation in the present study. The use of multiple methods can provide a more complete understanding of the phenomenon under investigation, while the use of multiple theories to contextualize the results can facilitate retroduction.

Denzin (1978) outlined four different types of triangulation: **(1) researcher triangulation**, which refers to having several researchers involved in the data analysis process, **(2) theory triangulation**, which refers to using multiple theories and perspectives to explain and understand the findings, **(3) methodological triangulation**, which refers to the use of multiple methods to explore the problem area, and finally **(4) data triangulation**, which refers to having multiple sources of data (Johnson et al., 2007).

Whilst triangulation is frequently quoted as an important aspect of qualitative research, some of these triangulation methods are more suited to the present methodology than others. As IPA stresses the idiosyncratic nature of both the experience being explored and the interpretation made by the researcher, researcher triangulation may not be the most suitable form of triangulation approach for IPA projects. According to the principles of IPA, it is likely that different researchers would arrive at different interpretations due to their previous experiences and knowledge. It would be problematic to claim that the interpretation of one researcher is superior to the interpretation of another. According to qualitative researchers, involving multiple

people in the data analytic process with the aim of achieving a consensus about the interpretations of the data does not increase the validity of the findings (Braun and Clarke, 2006, Braun and Clarke, 2014, Clarke and Braun, 2013). Achieving agreement on the interpretations would only prove that the researchers have been trained and educated similarly and hence see the data from similar perspectives. Therefore, such researcher triangulation was not used in the present study. On the other hand, two academics have been overseeing the data analytic process in order to ensure that the interpretations were logical, relevant and grounded in empirical data.

Theory triangulation and methodological triangulation are the most widely cited forms of triangulation in studies that adopt a critical realistic view. *Theory triangulation* involves contextualizing the findings using more than one theory. This is an important part of retrodution in critical realism and therefore suitable for the present methodological approach. Theory triangulation was achieved by drawing upon several different theoretical models of diagnostic reasoning, learning, and planned behaviour in order to contextualize and conceptualize the findings. *Methodological triangulation*, the combination of various research methodologies within one study was also achieved. A combination of in-depth interviews through an IPA approach, and an online questionnaire analysed through thematic analysis, descriptive statistics and non-parametric tests were used to explore the research problem. Through the various phases of the study, data was collected through multiple methods, from participants of different year groups in different settings which ensured *data triangulation*.

### 3.6 THE RESEARCH PROBLEM AND RESEARCH QUESTIONS

The **research problem** in the present study focuses on the diagnostic reasoning skills of senior medical students and foundation doctors. Diagnostic reasoning is an essential clinical skill that medical students will need to rely upon entering the real clinical world after graduation. However, educational interventions and assessment techniques that specifically target this skill have not yet been systematically implemented across medical schools in the UK. By better understanding how senior medical students make sense of the diagnostic process in their final years of undergraduate education, it may be possible to help prepare them for their graduation transition. Understanding how foundation trainees approach diagnostic consultations could also help direct medical students towards adaptive reasoning strategies that they can utilize in real clinical environments. The present project focuses on the setting of primary care, because it is an area where diagnostic reasoning is often put to a test because of ambiguous, undifferentiated problems; time pressure and limited availability of diagnostic tests. It was evident from the literature review (see Chapter 2), that the study of diagnostic reasoning in primary care is in its early stages. There is a scarcity of studies involving senior medical students or Foundation doctors performing diagnostic consultations in a primary care setting. Therefore, the present study adds to the existing literature by exploring the diagnostic reasoning strategies of medical students across the graduation transition in primary care. Understanding a primary care consultation from the perspective of the medical students and foundation year doctors is key to develop educational strategies to target diagnostic skills throughout the graduation transition in medicine. It was also expected that the project would allow an understanding of how the diagnostic reasoning skills of Year 4, Year 5 and Foundation Year trainees are different.

The **main research question** of the study can be defined as the following:

*How do senior medical students and Foundation trainees perceive and make sense of diagnostic consultations in simulated and real primary care settings?*

This was broken down into **four sub-questions** to specify the research objectives in the following way:

- a. What reasoning processes do senior medical students (Year 4) engage in during simulated primary care consultations?

- b. What reasoning processes do senior medical students engage in during real primary care consultations (Year 5)?
- c. What reasoning processes do foundation trainees engage in during routine, general practice consultations (FY2)?
- d. Do senior medical students in the UK hold views that are consistent with the main findings from Phase 1? (Penultimate and final year)?

In order to develop educational interventions that are based on the principles of deliberate practice (see Chapter 1), it is necessary to understand and take into consideration the existing level of knowledge and skills of the learners. Based on this, exploring the diagnostic skills of senior medical students and junior doctors is a prerequisite for developing effective educational intervention to achieve mastery in diagnostic reasoning. The findings of the present study therefore have important implications for the teaching of diagnostic strategies in general practice modules in undergraduate medical education and Foundation training.

### 4.1 INTRODUCTION

Chapter 4 outlines the research methods and analytical processes used in the present study. First, it is explained how the research design is used to address the research questions of the study. The present study is composed of four main phases:

- **Phase 1** involves the IPA study of 12 fourth year medical students
- **Phase 2** involves the IPA study of 2 final year medical students
- **Phase 3** involves the IPA study of 2 Foundation trainees
- **Phase 4** involves an online survey based on the findings from Phase 1

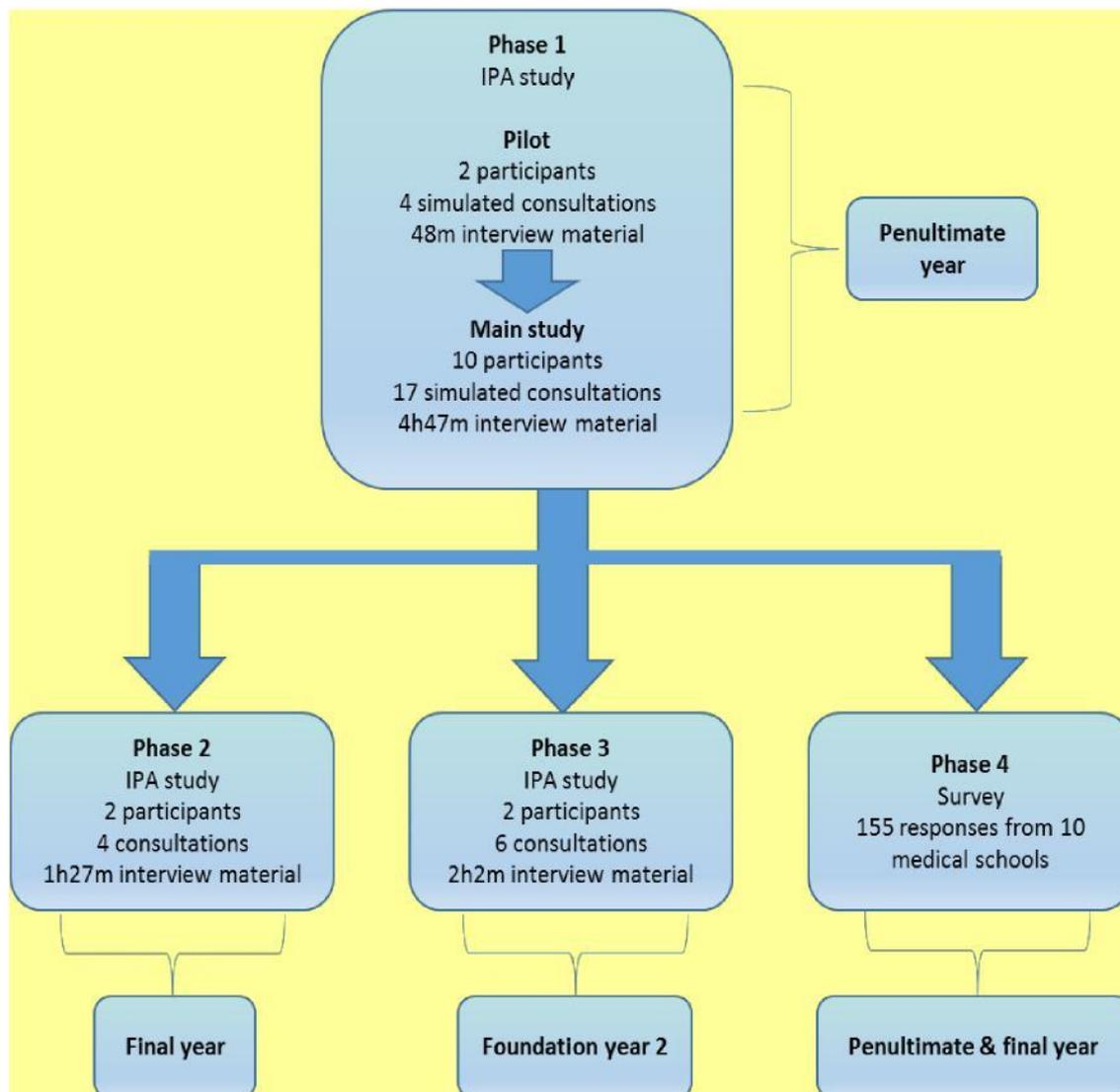
Once the research design is outlined, the practical implementation of the research is explained for each phase of the study. Phase 1 required obtaining research ethics approval from the Research Governance and Ethics Committee of Brighton and Sussex Medical School. Phase 2 and 3 on the other hand required approval from the Research Ethics Committee of the NHS and the Health Research Authority. Upon obtaining pre-engagement checks and approvals, the study proceeded with participant recruitment. Informed consent forms and participant information sheets were designed and used according to regulations. The main data collection tool for the first three phases of the study was video-stimulated, reflexive interviews, while Phase 4 utilized an online questionnaire for data collection.

Finally, the data analytic processes used in the present study are described. The main analytic process was Interpretative Phenomenological Analysis (IPA), which was used to explore the participants' lived experiences of diagnostic consultations in simulated and real primary care settings. It is outlined how through IPA, the researcher moved from raw data, through the various steps of the analytic process to subordinate and superordinate themes. The data analytic process of the survey data is also discussed.

## 4.2 RESEARCH DESIGN

The present study is composed of four distinct phases, as described below (See *Figure 9*).

*Figure 9: The detailed research design of the present study*



**Phase 1:** In order to test the feasibility of the IPA studies, a pilot study was conducted. Two volunteer fourth year medical students were filmed during Simulated Surgeries followed by video-stimulated reflexive interviews. The pilot study was reviewed by the researcher and the supervisors, in order to review feasibility and identify points for improvement in the procedures of the data collection. The pilot study was followed by the main study, which involved the recruitment of 10 more fourth year students to be filmed during their Simulated Surgeries and interviewed afterwards. The findings of Phase 1 prompted three further follow-up phases.

**Phase 2:** The findings of Phase 1 revealed that medical students see a discrepancy in their cognitions and behaviour in real clinical setting as opposed to the Simulated Surgery setting. In order to explore these claims further, the same cohort of medical students was followed into real PG practices during their final year. An IPA study of 2 final year medical students in real GP setting was carried out in order to explore the students' experiences of real diagnostic consultations.

**Phase 3:** During the Simulated Surgeries, students were instructed to think and act as if they were Foundation trainees working in real clinical practice. In order to explore how Foundation trainees really think during diagnostic consultations, an IPA study of two foundation trainees in real GP setting was carried out. Phase 2 and 3 also contributed to understanding the trajectory of diagnostic reasoning in a primary care setting.

**Phase 4:** The last phase consisted of an online questionnaire sent to all medical schools in the UK to enquire whether medical students in their penultimate and final years held views that were consistent with the main findings from Phase 1.

Linking the research questions to the research design

- a. What reasoning processes do senior medical students engage in during simulated primary care consultations? – Phase 1
- b. What reasoning processes do senior medical students engage in during real primary care consultations? – Phase 2
- c. What reasoning processes do foundation trainees engage in during routine, general practice consultations? – Phase 3
- d. Do senior medical students in the UK hold views that are consistent with the main findings from Phase 1? – Phase 4

### **4.3 PILOT AND PHASE 1: THE QUALITATIVE STUDY OF FOURTH YEAR MEDICAL STUDENTS' EXPERIENCES OF DIAGNOSTIC CONSULTATIONS IN SIMULATED PRIMARY CARE SETTING**

#### **4.3.1 Research Governance and Ethics**

Ethical approval for the project was obtained in line with the rules and regulations of Brighton and Sussex Medical School. The research proposal with all corresponding documents including the consent forms, information sheets, and interview guide submitted for evaluation for the Research Governance and Ethics Committee. The project was given favourable ethical opinion by the committee in October 2015 with minor amendments.

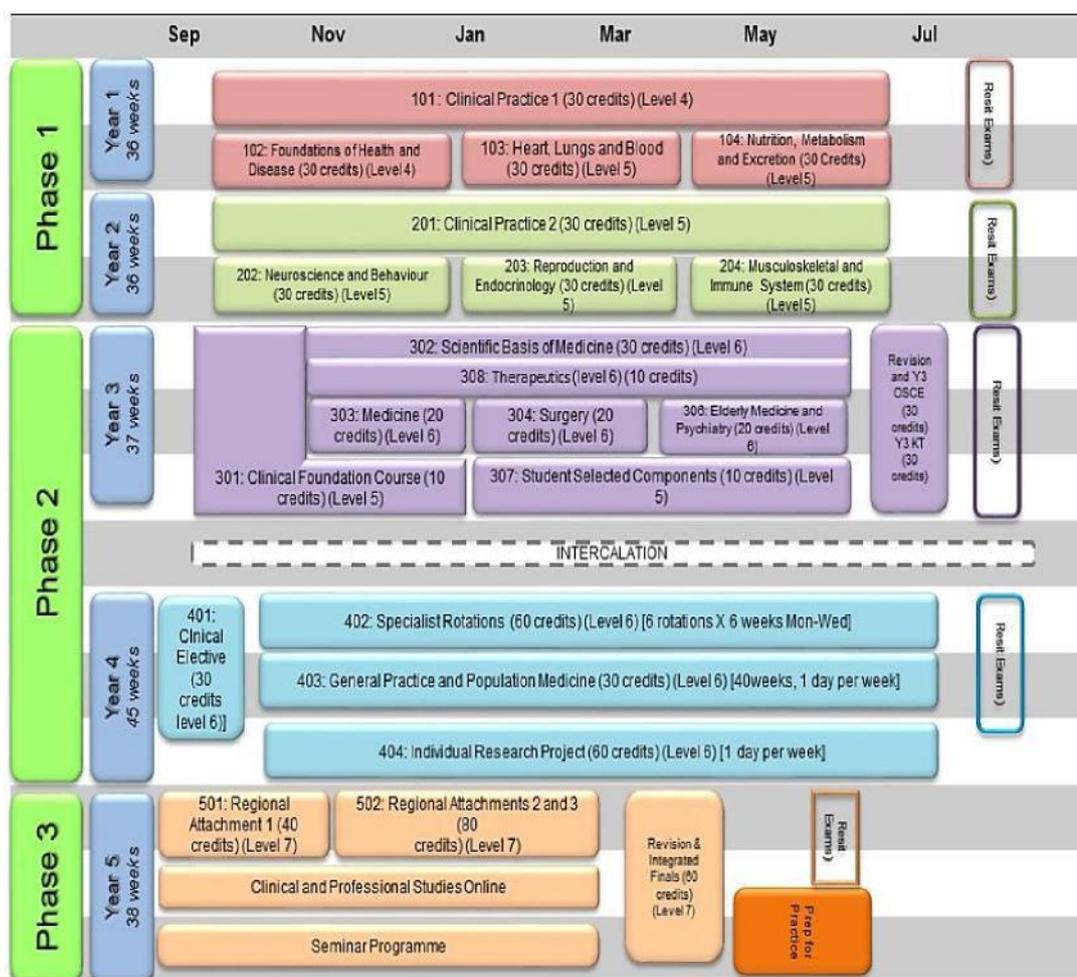
The consent form that the participants were asked to sign (See *Appendix B*) was to confirm that the participant has read and understood the Participant Information Sheet (See *Appendix C*) for the study and understood the procedures and possible risks. The researcher acknowledged that there was a small risk that participants would experience anxiety caused by being filmed for the study. To address this issue, participants were informed that participation in this study was completely voluntary and that they were free to stop at any time, without having to give a reason for doing so, and without any negative consequences for this action. They were also free to stop the recording at any time during the interview, and they were free to withdraw from the study at any point. However, none of the participants decided to withdraw from the study. Another measure taken towards this issue was to position the researcher and the recording equipment out of sight for the participants in the consultation rooms. The participants confirmed that this approach was effective in alleviating the feeling of being observed. Finally, participants were offered an optional debrief session and discussion with the academic supervisors of the project in case they felt that the filming interfered with their performance in any way. None of the participants has taken up this opportunity.

Finally, participants were informed that relevant sections of the data collected during the study would be used for research purposes, which involves the use of direct quotations in an anonymised form. All participants gave permission for their data to be used for this purpose.

### 4.3.2 Local medical school curriculum

The participants of the first two phases of the present study were recruited through the local medical school. Therefore, in order to understand the background of the participants, it was important to understand the structure of their curriculum (See *Figure 10*). The medical school, from which the students were drawn, has adopted an integrated curriculum and supports early patient contact during the preclinical years. Students have the opportunity for direct patient contact as early as the second week of their study program.

*Figure 10: Curriculum outline of the local medical school*



**Primary care** training is at the heart of the curriculum in the local medical school. Students have placements with GPs in the community in Years 1, 2, 4 and 5 of the program. In Year 1 and 2, medical students are allocated in pairs to a GP practice. Across the academic year, they attend the GP practice on six half-day occasions per year. Students are encouraged to take histories from the patients and perform examinations under direct supervision from their GP tutors. In year 4, general practice

training is delivered through Module 403, which presents general practice as a specialty in its own right. During the module, students learn the necessary skills to care for patients who present with early, undifferentiated symptoms or comorbidity. The module also involves Simulated Surgeries where students can put their skills to practice in a safe, supervised environment with simulated patients playing standardized patient roles. Finally, in Year 5, students spend four weeks at their designated GP practice. These placements culminate in student-led surgeries.

**Diagnostic reasoning** as an explicit educational theme was formally introduced to the undergraduate curriculum of the medical school in 2012. Initially, it started with a keynote lecture for the second year students, introducing the concepts of analytical and non-analytical reasoning processes (See Chapter 1). This lecture was immediately followed by small-group exercises, where students were solving written clinical reasoning problems. The same year, students were instructed to choose a patient with a specific problem from their primary care placement, take a history from them independently, and then carry out a focused examination under observation from the supervising GP. The GP was not commenting on the examination, but made sure that the patient was safe. Finally, the students were instructed to come up with a differential diagnosis and justification for it in a 1000-word essay. This was the first phase of diagnostic reasoning being introduced into the curriculum.

In the second phase, diagnostic reasoning has been incorporated vertically into the curriculum, from the first until the last year. In Year 1, a clinical workshop was held, in which students were presented with a list of symptoms and they were asked to try to piece them together. The approach to this exercise is Sherlock Holmes trying to solve a murder mystery. Through the workshop, they were also introduced to the notion of deductive and inductive reasoning. In Year 2, the previously described lecture and case study continued. Year 3 did not involve any specific diagnostic reasoning training. In Year 4, the General Practice module takes place. In preparation for this module, GP tutors were give a lecture on how to approach and introduce diagnostic reasoning into their teaching. This is important because many of the GP tutors have not themselves received any explicit diagnostic reasoning training before. Students are also given a lecture at the beginning of the module, which focuses on refreshing the material on diagnostic reasoning from previous years, and introducing the work of Heneghan and colleagues on diagnostic strategies in primary care (Heneghan et al., 2009). Finally, in

Year 5 the same GP tutor receives faculty training to ensure they incorporate diagnostic reasoning into the clinical training at GP placements.

### **4.3.3 The simulated surgery setting**

The Simulated Surgeries provide an opportunity for fourth year students to practice primary care consultations in a risk-free environment. The Simulated Surgery takes place within one of the teaching buildings of the local medical school, taking place 3 times a year: December, March and June. Each time they take up two whole teaching days, and each student is allocated to either of these days. When students arrive on the day, they are offered a pre-brief session. During the pre-brief session, students are told that the Simulated Surgery is similar to the Objective Structured Clinical Examinations (OSCEs), but without the assessment element. It is emphasized that the aim of the Simulated Surgery is to provide an opportunity for them for practice in a safe environment with feedback provided by their regular GP supervisors, who act as simulation facilitator during the Simulated Surgery. The students are then organized into pairs. They are informed that during the surgery they will need to alternate the leading role, while the other student acts as an observer.

Following the pre-brief, students move to the stations. Students are instructed to go through seven stations, situated in seven rooms along the same corridor. There is a short, printed instruction on the door of each station, to instruct the student to act like a junior doctor, take focused history from the patient and decide on the management plan. Each station is set-up the same way, with a desk in the middle with four chairs around it. A facilitator and an actor are sitting on one side of the table, while opposite them, there are two empty chairs for the students to take. On the table, the students have paper and pen for notes, and any props that need to be used at the station. In front of the facilitator, there is an evaluation checklist, which they complete as the simulation is going on. These checklists are similar to those used for the OSCEs. Once the simulation is over the facilitator gives the completed checklist to the students, and provides verbal feedback about the student's performance.

During the simulation, the time is signalled in similar routine as during real OSCEs by a designated timekeeper. A walky-talky is placed in each room and on the corridor to deliver the instructions. At the beginning, students are instructed to start the station, then after 5 minutes they are reminded of the remaining time, at 7 minutes they are instructed to finish the consultation and proceed to feedback, and finally after 10 minutes they have a signal that the station is over and they need to move on to the next station.

#### 4.3.4 Video-stimulated recall

During diagnostic consultations, medical students do not necessarily articulate all aspects of their reasoning process, which means that much of their thinking process might not be directly observable. One method for identifying covert assumptions and arguments is to explicitly instruct the participants to engage in observing their own internal mental processes and verbalize their thought processes and cognitive content, thereby making it accessible for the researcher. This is called the **think-aloud** technique and is frequently used in research studying cognitive content. Think-aloud can be carried out concurrently while participants are carrying out a task, or retrospectively, after the completion of the task. During concurrent think-aloud, participants are asked to verbalize their thoughts as a running commentary. This technique is also called **reflection-in-action**. It is considered to be an invasive technique and requires substantial training of the participants for optimal results (Gass and Mackey, 2000). For the present research project, this would not be an appropriate technique for a number of reasons. First, it would have largely interfered with the natural flow of the consultations. Secondly, it would have increased the cognitive load of the task (Branch, 2000, Karsenty, 2001). Finally, it has been a consistent finding that in order to engage in concurrent think-aloud procedure, participants need to slow down their actions, as it is impossible to verbalize everything as fast as they would naturally happen (Afferbach and Johnston, 1984, Ericsson, 1993). Due to the inherent time constraint of primary care consultations, this would have been problematic in the present study.

The think-aloud technique can also be used retrospectively, after the event of interest has taken place. This research technique is called **reflection-on-action**, where individuals are asked to verbalize their cognitive processes after participating in a task. To assist the recollection of past events, this technique is often augmented by an audio or video recording of the event. In the present study it was important that the interview revealed the experiences of the participants as authentically as possible, and therefore the reflections were supported by watching the video recording of the consultations. The video recording allowed the participants to relive the simulated scenarios to support more accurate recall of their experiences. *Video-stimulated recall* is a research method in which an event is first video recorded and afterwards, the person taking part in the event is asked to recall what they were thinking during the event while watching the video. It is a widely used technique, especially in the field of education. It is a technique that can help explore cognitive processes relating to certain events in a much less intrusive way than using alternative techniques, such as reflection-in-action (Nguyen et

al., 2013). However, there were certain methodological issues that needed to be addressed in order to ensure the rigour of this type of data collection (Henderson and Tallman, 2006):

- 1. Time gap:** It has been established that the time elapsed between the lived event and the recall of the event has a significant influence on the accuracy of the recall (Garner, 1988, Bloom, 1954). Both Bloom (1954) and Garner (1988) found that the accuracy of the recall of events started to significantly decline 48 hours following the event (Garner, 1988, Bloom, 1954). These studies suggest that in order to ensure the reliability of the recall, the time between the task performance and the stimulated recall interview had to be minimized. The reflexive interviews took place on the same day as the consultations, less than an hour apart. This ensured that the memory of the event remained easily accessible for the participant to reflect on.
- 2. Capturing task performance:** The video recording of the task acts as a memory retrieval cue and has high associative strength (Henderson and Tallman, 2006). Using a video prompt lowers the risk of fabrications and makes it more likely to trigger accurate memories (Henderson and Tallman, 2006). Also, as an added benefit for the participants, it has been found that the recalling one's own thoughts of an event can strengthen the overall memory of that event (Ericsson, 2002).
- 3. The interview process:** Smith, Flowers and Larkin (2009) suggests that in-depth, semi-structured interviews are the most suitable data collection tools for IPA studies (Smith et al., 2009). In line with this view, the IPA phases of the present study all relied on semi-structured interviews. During video-stimulated recall, it is important that the interviewer is supportive and non-judgemental towards the interviewee (Henderson and Tallman, 2006). It has been recommended that the interviewer should keep questioning to a minimum, refraining from complicated and leading questions. At the beginning of the interview the interviewer needs to instruct the interviewee to recall what they were thinking during the event, while they should also reassure them that it is okay if they cannot remember parts of the event or if they were thinking about something other than the task at hand during the event (Henderson and Tallman, 2006). Furthermore, it is important that the interviewer takes caution with the prompts used during the interview. Prompts should be non-directive ("*What were you thinking then?*"), they should involve the specific content being viewed ("*What were you thinking when the patient said that?*"), and they

should seek confirmation that the thought was there at the time of the task and not fabricated during the time of the interview (“*Did you think that when you were in the simulation exercise, or did you just think of it now?*”) (Henderson and Tallman, 2006).

Video-stimulated recall has been used in primary care research (Paskins et al., 2014). A systematic literature review carried out by Paskins, McHugh & Hassel (2014) to explore the use of video-stimulated recall in primary care research identified 28 publications. Four of these articles focused on decision making in primary care. Three of them looked at expert decision making in specific circumstances: patients undergoing health maintenance examinations; looking at why GPs discuss smoking with some patients and not others; and investigating reasons for non-disclosure of information in family planning and diabetes clinics. In the last article, they looked at the power relationship during triadic decision-making when GP, medical student and patient are all present during a consultation (Treichler et al., 1984). The fact that this research method has been used repeatedly in primary care to investigate cognitive processes of healthcare professionals is a good indication that it was going to be a suitable data collection method for the present research project.

In the present study, in line with the recommendations of Henderson and Tallman (2006) listed above, task performance was captured through video recording by the researcher, and reviewed shortly after the task was performed. During the interviews, the researcher took on a non-directive role, in line with the methodological recommendations, utilizing neutral prompts of “*What were you thinking then?*”, “*What were you thinking when the patient said that?*” and confirmatory prompts, such as “*Did you think that when you were in the simulation exercise, or did you just think of it now?*”. The researcher encouraged the participants to pause the video whenever they could remember what was going through their mind during the consultations. It was expected that some participants may be occasionally distracted by focusing on viewing the recording instead of recalling their thinking process, because for some this was the first opportunity to view their own performance. However, during the interviews, it was predominantly the participants and not the researcher who paused the video. The researcher only intervened when the participants themselves have not stopped the recording for a considerable length of time, as this was interpreted as the participant was too immersed in the video without concentrating on the recalling task.

#### **4.3.5 Participant recruitment and data collection**

IPA studies generally involve small, homogeneous, purposive samples (Reid et al., 2005, Hefferon and Gil-Rodriguez, 2011). Therefore, in the present study, medical students of the same cohort were purposefully sampled. First, the pilot study was conducted in order to familiarize the researcher with the setting, to explore the practical constraints of the setting, and to test the feasibility of the data collection procedures. The pilot study started with participant recruitment. All fourth-year medical students at the local medical school who were enrolled in the General Practice module 403 during the 2015/2016 academic year were sent an email advertisement about the study through an independent administrator. The advertisement contained the contact details of the researcher that students who were interested in the study could forward their inquiries to. Students were also told about the opportunity to participate in the study during their primary care lectures. There were no exclusion criteria imposed in terms of age, gender, nationality, or otherwise. In the first instance, two students volunteered for the study. They were given the participant information sheet to read and were encouraged to ask any questions they may have. They were also asked to read and sign the informed consent form before participation. As the students go through the simulated stations in pairs, the assigned student pair of each volunteer was also informed about the filming and verbal consent was obtained from them for the filming as they were likely to appear in the background of the video footages. On the day of the Simulated Surgeries, written consent was obtained from all actors involved in the scenarios to be filmed and verbal consent was obtained from all the clinical facilitators who would appear on the footage.

During the Simulated Surgeries, the researchers shadowed the volunteers throughout all their stations. The filming was carried out by attaching an iPad to a tripod, and placing that at the side of the consultation rooms. IRIS Connect software was used to record the consultation, which immediately uploads and stores the videos on a secure website.

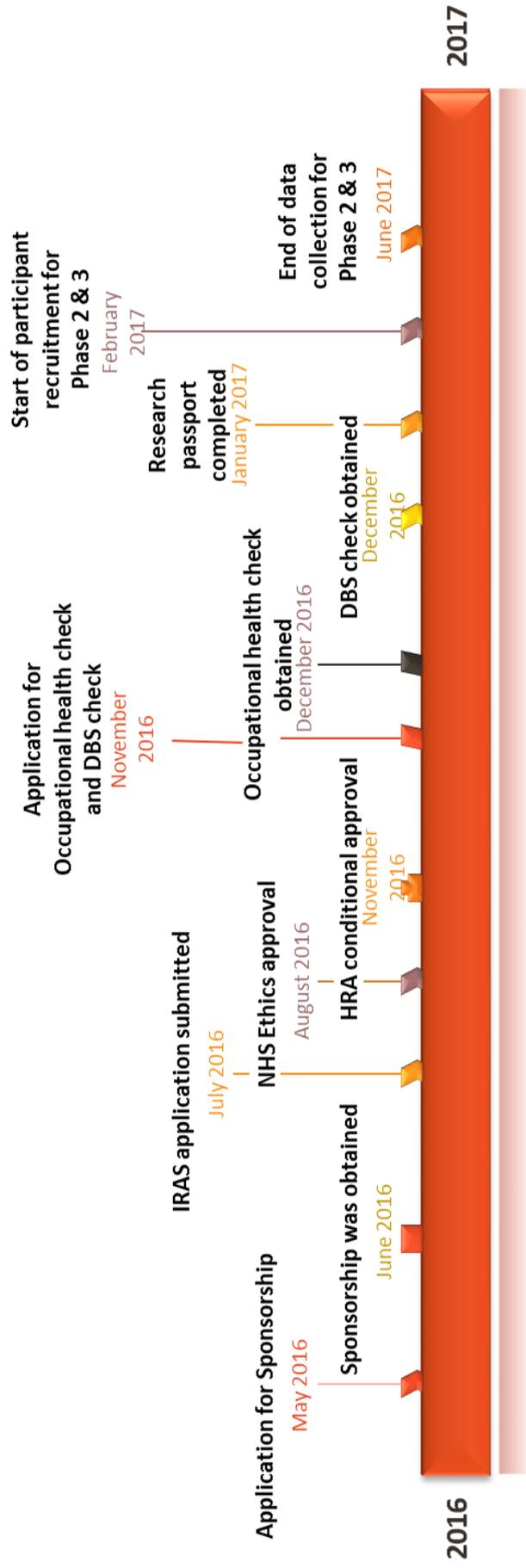
During the consultations, the researcher was seated at the back of the room, out of sight for the students. Once all the stations were completed, participants were asked to join the researcher in a quiet room for the semi-structured reflexive interview. The video-stimulated interviews took place in accordance to the recommendations of Henderson and Tallman (2006), outlined previously. During the interviews the participants were asked to review their consultation and reflect upon their experiences (See *Appendix A*). The interviews were audio recorded and later transcribed verbatim by the researcher.

#### **4.4 PHASE 2 AND PHASE 3 – THE QUALITATIVE STUDY OF FINAL YEAR MEDICAL STUDENTS’ AND FOUNDATION DOCTORS’ EXPERIENCES OF DIAGNOSTIC CONSULTATIONS IN REAL PRIMARY CARE SETTING**

##### **4.4.1 NHS Ethics and Sponsorship**

Phase 2 and phase 3 moved the study into real primary care settings. The ethical procedures were in accordance with current NHS guidelines (See *Figure 11*). First, sponsorship application for the project was submitted in according to the rules and regulations of BSMS. Informed consent forms and participant information sheets for both the participants (See *Appendices D and E*) and the patients (See *Appendices F and G*) were designed and submitted with the application. A detailed data management plan was also designed in order to make sure data is stored, accessed and transferred securely during the study. The University of Sussex accepted the responsibility to act as the lead sponsor for the study. Following the obtainment of the sponsorship, NHS ethical approval was attained. This application process was made via the Integrated Research Application System. The project was first reviewed and approved by East of England - Cambridgeshire and Hertfordshire Research Ethics Committee via Proportionate Review Service, and subsequently by the Health Research Authority. Approvals were subject to minor amendments and the condition of obtaining a research passport for the chief researcher. For the research passport, the researcher obtained an Occupational Health Check and a Disclosure and Barring Service check. Once the research passport was completed, participant recruitment could start for phase 2 and phase 3 in February 2017.

**Figure 11:** The timeline for Phase 2 and Phase 3 of the present study



Ethical considerations for the final year medical students and foundation doctors included that they may experience increased performance anxiety due to the filming. The same measures were taken as in Phase 1: positioning the researcher and the recording equipment out of sight for the participants, informing participants that they are free to stop and withdraw from the study at any point without any repercussions, and offering an optional debrief session. However, none of the participants reported increased anxiety, and none of the participants withdrew from the study or requested a debrief session. It was also ensured, that if while reviewing the recordings, the participants would recognize an error they have made during the consultation, their supervisors would be informed to ensure the appropriate measures were taken to rectify that error.

The main ethical considerations with respect to the patients involved having mental capacity, voluntary participation, and informed consent. Only patients over 18 years were asked to participate in the study. There was also a risk that patients may not have mental capacity to consent or in rare cases they may lose capacity during the consultation. In order to address this, the final year medical students and junior doctors were asked to judge the mental capacity of the patients by filling in a standard capacity assessment form after the consultations to ensure that all patients involved in the study had capacity to consent.

There was a potential risk that some patients may not want to be filmed during their consultations, especially if their consultation was likely to involve an issue of sensitive nature or intimate examinations. To address this, participation was completely voluntary, only patients who were comfortable with being filmed were recorded. Intimate examinations were not filmed. Patients could also request for parts of their consultation not to be filmed. However, all the patients who decided to participate agreed to have their entire consultation filmed.

Another consideration was that patients may disclose information during the consultation that retrospectively they would not wish to be recorded. This was addressed by making sure to take consent both at the beginning and at the end of the consultations.

Another consideration was that patients may change their mind about participating in the study during or after the consultation. This concern was especially important

considering the short deliberation time patients had to decide about participation. Therefore, participants were asked to sign a consent form both at the beginning and at the end of the consultation to ensure they were still happy to participate. They were also given a cooling-off period of one week, in which time they were allowed to withdraw from the study and request all their material to be deleted. However, none of the patients decided to withdraw from the study.

Finally, as the time for informing patients about the study was limited, the patients were given a leaflet with detailed information about the study to take home, which involved contact details for the researcher, the supervisors, and information about the NHS complaint procedures. None of the patients took up this opportunity.

#### **4.4.2 Participant recruitment and data collection**

##### ***4.4.2.1 Phase 2 - Final year medical students***

GP practices that provide placements for 5th Year BSMS students were contacted, from which two practices have agreed to facilitate the study. Those final year BSMS students, who were assigned to these two surgeries were contacted and informed about the study. Once participants were identified, a convenient date and time was agreed with them for the researcher to visit the practices to film some of their morning surgeries. Patients who were about to see the participants were informed at reception about the study. Only patients who consented to be filmed and signed an informed consent form were involved in the study. The filming was carried out by placing an iPad on a tripod in the corner of the consultation room. IRIS Connect software was used to record the consultation, which immediately uploaded and stored the videos on a secure website. Once the morning surgeries were over, participants reviewed some of their consultations with the researcher and reflected on their experiences through semi-structured interviews. The semi-structured interviews utilized the same interview guide as was used in Phase 1. The interviews were audio recorded and transcribed verbatim by the researcher. All details that could be used to identify participants (e.g. name, age, GP practice) were removed from the transcripts or given pseudonyms. Each participant was assigned a unique participant number, and all the data collected from the same participant was identified by their participant number.

#### ***4.4.2.2 Phase 3 - Foundation Year 2 doctors***

South Thames Foundation School was contacted for assistance on recruiting Foundation trainees and GP practices to participate in Phase 3 of the study. The Foundation School agreed to cascade the information about the study to all practices in Sussex and East Surrey who currently provided foundation placements. The BSMS Alumni office was also contacted and they have placed an advertisement about the study in their newsletters. Finally, the researcher personally attended a training session for the Foundation doctors in order to raise awareness of the study. The GP practices, who have previously participated in Phase 2 of the study were also informed about Phase 3. Once signed up for the study, participants were sent information sheets about the study and were asked to suggest a convenient date and time for the filming. Before the filming has started, participants were asked to sign the informed consent form. Patients who were scheduled for the morning surgeries were also informed about the study. Only those consultations were filmed where the patient has given informed consent for participating in the study.

## **4.5 PHASE 4 – SURVEY EXPLORING PENULTIMATE AND FINAL YEAR MEDICAL STUDENTS EXPERIENCES OF OSCÉS AND REAL PRIMARY CARE CONSULTATIONS**

### **4.5.1 Research Governance and Ethics**

Ethical approval for the project was obtained in line with the rules and regulations of Brighton and Sussex Medical School. The research proposal with all corresponding documents including the questionnaire, the letter to the gatekeepers, and the advertisement for the students were all submitted for evaluation for the BSMS Research Governance and Ethics Committee. The project was given favourable ethical opinion by the committee with minor amendments.

The online questionnaire started with an information leaflet for the participants, which explained the confidentiality and privacy aspects of the data collection (See *Appendix D*). Participants were informed that participation in the online survey was completely voluntary and that they were free to withdraw from the study at any point without having to provide a reason, or ask for their data to be removed from the study if it was before the point it has been included in the final PhD thesis draft or any publications. Questionnaires were completed anonymously and returned indirectly. Each participant was assigned a random identity number which linked the data received from them back to their name and contact details. The participants' names and contact details were stored securely and separately from the research data. All place and institution names which could have led to the identification of individuals or organisations were removed from the data. All personal information gathered was treated in strict confidence and never disclosed to any third parties. Research records were held in accordance with the data protection guidelines of Brighton and Sussex Medical School. The research data was not to be used for any purpose other than that which consent was given for. All participants of the self-completing a questionnaire were informed that returning the completed questionnaire implied consent to participate. There were no special procedures for obtaining consent in advance of completing the questionnaire. Completion of the questionnaire by the participant was evidence that participants consented to participate in the questionnaire part of this study. They were informed about this on the 'Instruction' page of the survey. Although participants were asked which medical school they attended, this information was assured not to be linked with their answers to the other questions. This information was only used to report how many of the 33 medical schools in the UK took part in the survey.

#### 4.5.2 Participant recruitment and data collection

An electronic message outlining the study was sent to gatekeepers (i.e. Undergraduate Leads) at each of the 33 medical schools in the UK. They were asked to distribute the attached email advertisement with a direct web-link to the online questionnaire for their penultimate year and final year medical students. There were no exclusion criteria imposed in terms of age, gender, race or otherwise for the students to participate. Questionnaires were distributed electronically, and participants could complete the questionnaire in their own time from any computer.

The aims of the survey were to enrich the findings of the study, to expand the scope of the findings and to triangulate the findings of phase 1. The survey intended to address to following research questions:

1. Do penultimate and final year medical students across the UK have similar OSCE experiences with respect to diagnostic reasoning as found in phase 1 of the present study?
2. Do the experiences of penultimate medical students differ from the experiences of final year medical students in real primary care and OSCE settings?

When considering the appropriate sample size for the survey, the approximate number of medical student cohorts in the UK was researched. According to the estimates of the King's Fund, around 6000 medical students graduate each year in the UK (The King's Fund, 2014). Based on this data, using the following formula:

$$n = N * X / (X + N - 1),$$

where,

$$X = Z_{\alpha/2} * p * (1-p) / MOE^2,$$

and  $Z_{\alpha/2}$  is the critical value of the normal distribution at  $\alpha/2$ , MOE is the margin of error,  $p$  is the sample proportion, and  $N$  is the population size, with the confidence interval of 95%, a margin of error of 5%, and z-score of 1.96, the sample size for parametric tests should be 362 for this year group. As there was no available data for the penultimate population, the same estimate was used for their group as well.

Since the present study intended to use a non-parametric test (i.e. the Mann Whitney U test), the Pitman Asymptotic Relative Efficiency was used to inflate this sample size (Hollander et al., 1999, Randles and Wolfe, 1979). It is assumed that the Asymptotic Relative Efficiency of the Mann Whitney U test can never be worse than 0.864 for a reasonably broad class of probability distributions, which would imply increasing the sample size by a factor of 1.157 (Lehmann, 1975). That meant that the study aimed at achieving a sample size of 419 per year group.

## 4.6 DATA ANALYSIS

### 4.6.1 The Interpretative Phenomenological Analysis (IPA) process

Each reflective interview was audio recorded and transcribed by the researcher. Although there is no single, right way to carry out Interpretative Phenomenological Analysis (IPA), and creative innovation is encouraged for the analytic process, there are some key strategies that are common to all IPA studies (Smith et al., 2009). The present analysis followed the guidelines of Smith, Flowers, and Larkin (2009), which describe those key strategies (Smith et al., 2009). According to them, the IPA analysis can be broken down into the following seven phases, which should be used in an iterative and inductive cycle (Smith et al., 2009, Smith, 2007):

- 1) The analysis begins by **reading and re-reading the transcribed data**. This is necessary in order for the researcher to get familiar with the interview material. In the present study, the transcription process was completed by the researcher, which ensured high level of the immersion in the data early on. Once the interviews were transcribed, the researcher kept re-reading them in order to encourage active engagement with the data.
- 2) Once the researcher is familiar with the data, the **initial coding** process can begin (Smith, 2007). This close, line-by-line analysis is the most detailed and time-consuming step of the analytic process (Larkin et al., 2006, Smith et al., 2009). The researcher carefully examines the data, making initial comments and notes about the scripts. The initial codes can involve descriptive, conceptual, and linguistic comments about the data. Descriptive comments summarize the participant's experiences and interpretation. Linguistic comments focus on the language use of the participants. Conceptual comments reflect the researcher's

interpretation of the data. This initial coding often takes an interrogative form at the early stages of analysis, and it links the data with the conceptual knowledge of the researcher. It is advised to keep these different types of comments distinguishable during the analytic process in order to make it clear what constitutes to the participants' interpretation and what to the researcher's secondary interpretation. In the present study, primary descriptions and interpretations were written in plain text, secondary interpretations were underlined, and linguistic comments were italicised. All of these comments of the initial analysis were presented on the right margin of the transcripts. According to Smith and colleagues (2009), it is important to keep the text and the comments together at this point, because the connection between these two is critical in order to allow the researcher to engage in deep analysis (Smith et al., 2009). These provisional comments form the basis of the next step in the analysis.

- 3) Once the initial coding of the transcript has been finished, the focus of the analysis shifted from the transcript itself to the exploratory comments. Connections, relationships and patterns are looked for in these comments in order to **develop broad, emergent themes**. These are written on the left-hand side margin of the transcripts. These themes are tentative at this point and likely to change through the next stages of the analysis.
- 4) The next step is to write down all the themes in chronological order, and start searching for **connections across these emergent themes**. The researcher at this point is trying to search for common features and shared meanings that could cluster the themes. This clustering process will form larger, superordinate themes through the process of *abstraction* and *subsumption*, and narrower, subordinate themes through *polarization*. Abstraction means grouping similar themes together to form one broader, superordinate theme. Subsumption on the other hand is the process where an emergent theme itself is elevated to the superordinate level. Polarization involves focusing on the differences between themes instead of similarity and thereby splitting up themes into smaller, but more homogeneous sub-themes. The researcher may also use *numeration*, which shows the frequency with which each theme is represented in the original data. While this could be a useful way of describing the data, frequency alone should not be used as the indicator of the importance of various themes, as themes can

play very significant role even if they only appear in one transcript.

*Contextualization* can be another useful way to look for connections between themes. As all themes appear in the narrative of the participant, the relative timing and location of particular themes within the broader transcript may provide insight into the understanding of the theme.

This step of the analytic process involved moving the themes around, developing mind maps to explore how themes could fit together. During this process, the researcher keeps returning to the original text and comments in order to continuously check the emergent pattern of themes against the original data in an iterative process. The emergent themes are then re-presented in a coherent order, together with relevant quotations from the original transcript. At this stage, some comments and themes may be dropped if they do not add value to the overall analysis.

- 5) Once the above analytical steps are completed for the first transcripts, the researcher is ready to **move on to the next case**. At the present study the analysis was started from scratch at each transcript instead of using the themes of the previous transcripts as a template in order to keep with the idiosyncratic focus of IPA.
- 6) Once all cases are analysed, the researcher starts **looking for patterns across cases**. The researcher is looking for how the themes relate to each other, which themes are the most prominent, how can the theme in one transcript illuminate a theme in another. This way the researcher is attempting to capture the essence of the students' experiences.
- 7) Finally, the last phase of the analytic process is the **writing-up** itself. The results are presented in a narrative account, richly illustrated with direct quotations from the transcripts in order to show the reader the results of the analytic process. The findings are generally presented first, followed by the contextualizing the findings in terms of existing literature, which generally forms the discussion part of the paper.

These guidelines of the data analytic process were followed in the present study. The data analysis was carried out by the researcher and validated by the researcher's

academic supervisors. The researcher sent the supervisor regular updates and reports to review throughout all stages of the data analytic process. The supervisors provided feedback about the analytic work. However, due to the requirements of the PhD to be the original work of the researcher herself, the supervisors' role was not to provide additional interpretative analysis for the study, but rather to ensure that the work is sound, the arguments are logically valid, and the interpretations are grounded soundly in empirical data. This approach was also consistent with the theoretical framework of the present study. When the supervisors identified areas where the researcher's arguments did not seem to be supported strongly enough by the empirical evidence provided, the researcher went back to the data to find further supportive evidence, or decided to abandon the argument in the lack of sufficient evidence.

#### 4.6.2 Data analysis of the survey data

The national survey was based on an online questionnaire that was sent out to all medical schools in the UK. From the 33 medical schools, 10 agreed to distribute the survey for their penultimate and final year students. Within the time frame of two month, 73 penultimate students and 82 final year medical students completed the survey. The survey involved both open-ended questions and Likert-scale items. The responses to the open-ended questions were analysed using thematic analysis to identify and describe the most prominent themes in the data. Thematic analysis (TA) is one of a widely used research method in qualitative data analysis. It first appeared in the 1970s (Clarke and Braun, 2013, Braun and Clarke, 2014), and although there have been many different variations proposed (Vaismoradi et al., 2013, Aronson, 1994, Attride-Stirling, 2001, Boyatzis, 1998), essentially, the aim of all thematic analysis is to identify and analyse patterns in qualitative data (Smith, 2015b, Braun and Clarke, 2006). TA has a variety of uses depending on the research questions: it can be used inductively or deductively; it can focus on semantic or latent themes; it can describe the whole data set or a particular aspect of it; and the basic definition of what counts as a theme can vary. It was decided that the present study would use inductive, semantic, data-driven analysis, where themes are defined as a patterned response that captures an important aspect of the data in relation to the research questions. The thematic analysis process followed the guidelines of Braun and Clarke (Braun and Clarke, 2006).

For the Likert-scale items, two types of analysis were carried out. First, the questions were organized into themes (See *Appendix J*), and descriptive statistics of the percentages of responses was used to describe the pattern of responses within those themes. Second, non-parametric tests were used to compare the distribution of answers between the two year groups. The Wilcoxon-Mann-Whitney test was used to compare the distribution of responses of penultimate and final year medical students to each question of the survey and to determine whether there is a significant difference between the two year groups. The Wilcoxon-Mann-Whitney test is a non-parametric test that is suitable for the present study, because as opposed to parametric tests, the Wilcoxon-Mann-Whitney test does not rely on the assumption that the dependent variable is a normally distributed interval variable (Cohen et al., 2002, Pett, 1997, Clegg, 1998, Jamieson, 2004).

### 5.1 INTRODUCTION

Chapter 5 encompasses the findings of the study. First, the participant sample for each phase is described. Following the participant section, the findings are divided up into four main sections based on the four phases of the study. First, the IPA findings from Phase 1, Phase 2, and Phase 3 are presented. The phenomenological and hermeneutic elements of IPA together form the main body of these sections, supplemented with direct quotations from the interviews to illustrate and support the emergent themes. The use of these direct quotations is vital as they allow the reader to become part of the hermeneutic dialogue (Smith, Flowers, Larkin, 2009, pp.109). Following the IPA findings, the results of the online survey are presented. Descriptive analysis has been carried out for both open-ended and Likert-scale questions and the findings are summarized separately for penultimate and final year participants. Finally, results of the comparative analysis between the two year groups are presented.

## 5.2 PARTICIPANTS

### 5.2.1 Phase 1

During the pilot study, the two volunteers reviewed and reflected on four simulated scenarios. The pilot study revealed that the setting was suitable for the study, however, the equipment used to record the consultations and the subsequent interviews needed to be adjusted in order to optimize results. An additional microphone was purchased to improve the sound quality of the recordings. The pilot study also confirmed that the proposed interview questions were suitable for prompting reflections on diagnostic reasoning. Finally, it was decided that in order not to lose valuable data, the interview material of the pilot study would be included in the main study during data analysis.

Following the pilot, 10 more students volunteered to participate in the study. In total, 21 simulated GP consultations were filmed, involving 12 fourth year medical students, 7 females and 5 males (See *Table 5*). The interviews took on average 28 minutes per participant (min: 14minutes, max: 44 minutes), totalling up to 5 hours and 35 minutes of interview data.

**Table 5:** *The participant list of Phase 1 of the present study*

Participant #	Gender	Scenarios reflected on	Interview length (min:sec)
#1	Female	Viral Gastroenteritis Urinary Tract Infection	29:28
#2	Male	Viral Gastroenteritis Urinary Tract Infection	18:57
#3	Female	Chest pain COPD	32:39
#4	Female	Panic attack Back pain	43:53
#5	Female	Panic attack Back pain	37:59
#6	Female	Chest pain COPD	27:16
#7	Male	Panic attack Back pain	36:33
#8	Male	Chest pain COPD	33:44
#9	Male	COPD	17:20
#10	Female	Back pain	18:13
#11	Female	Eye pain	14:35
#12	Male	UTI in pregnancy Testicular lump	24:55

### **5.2.2 Phase 2**

Two final year medical students volunteered to participate in Phase 2 of the study, 1 female and 1 male. Due to time constraints, the first participant could only reflect on one diagnostic consultation, while the second participant reflected on three. The patients' problems presented during the consultations involved depression, leg injury, high blood pressure, and cough. The participants were given 20-30 minutes for each consultation. The video-stimulated interviews provided 1 hour and 27 minutes of data.

### **5.2.3 Phase 3**

Two Foundation doctors, 1 female and 1 male, volunteered for the study from two separate GP practices. Both participants have studied in the same medical school and attended the same Foundation training, which ensures that this participant sample remained homogeneous. The foundation trainees were filmed across 3 consultations each, during their routine morning surgeries. The patients' problems presented during their consultations involved back pain, ear bleeding, breathlessness, high blood pressure, panic attack, eczema and hay fever. Each consultation lasted for approximately 30 minutes. The video-stimulated interviews provided 2 hours and 2 minutes of data.

### **5.2.4 Phase 4**

However, due to time limitations in the administration of the survey, only a fraction of the anticipated sample size was achieved. 73 penultimate year medical students filled out the questionnaire, from 7 different UK medical schools, with the average age of 23 years (age =  $21.15 \pm 4.08$  years), and 82 final year medical students completed the questionnaire, from 8 different UK medical schools, with the average age of 24 years (age =  $23.85 \pm 2.26$  years). This means that the response rate was just over 1 per cent for each year group. This means at a 95% confidence interval the present data has an 11.5% margin of error for the penultimate year group and a 10.8% margin of error for the final year group.

### 5.3 PHASE 1 - IPA FINDINGS

The interpretative phenomenological analysis of the fourth-year medical students' interviews based on their experiences of simulated GP consultations revealed three overarching, superordinate themes, and eleven subthemes (See *Table 6*). The presence of data extracts within individual transcripts representing these themes are presented in the *Appendix H* to highlight the divergence and convergence of data from the 12 participants.

The superordinate themes were (1) *the OSCE effect*, (2) *diagnostic reasoning*, and (3) *challenges in consultation skills*. The first superordinate theme revolved around the OSCE setting of the simulated consultations. This theme involved students' perceptions about how their diagnostic thinking and behaviour changes in an OSCE situation as opposed to real clinical practice and how an OSCE setting influences their perceptions of the diagnostic consultation itself. The second theme involved the students' reflections about the diagnostic strategies they used during primary care consultations, the characteristic features of their thinking process during the diagnostic process, their approach to the decision-making role with regards to diagnosis and management, and their views about their future competencies in these areas. Finally, the third theme comprised the students' reflections about the challenges they experience with regards to consultation skills in primary care.

**Table 6:** Themes based on the Year 4 interviews

#### **Superordinate theme I – THE OSCE EFFECT**

- Theme I – 1. Artificiality of the scenarios
- Theme I – 2. Contextual pressure
- Theme I – 3. Lack of reasoning and ticking boxes

#### **Superordinate theme II – DIAGNOSTIC REASONING**

- Theme II – 1. Generating initial list of differentials
- Theme II – 2. Narrowing down the differentials
- Theme II – 3. Relying on memorized lists
- Theme II – 4. Using examinations and test results
- Theme II – 5. Metacognitive interference
- Theme II – 6. Diagnosis and management

#### **Superordinate theme III – CHALLENGES IN CONSULTATION SKILLS**

- Theme III – 1. Interpersonal skills
- Theme III – 2. Communication skills

### 5.3.1 The OSCE effect

It was evident from early on during the data collection that the Simulated Surgeries bear strong resemblance to Objective Structures Clinical Examinations (OSCEs). The physical set up of the consultations rooms, the general instructions for the students, the time pressure of the consultations, the simulated patients and the presence of the supervisor with an assessment checklist all resembled OSCE settings. For these reasons students perceived the consultations primarily as mock OSCE stations. This was evident by the fact that every participant in the present study referred to the resemblance between the Simulated Surgeries and OSCEs during their reflective interviews.

*“...it’s **very similar to the real OSCE situation**” (P#5)*

*“...it is **useful to practice the OSCE situation**” (P#2)*

*“...I think it is a **great way to learn, just forcing you to have that OSCE situation**” (P#11)*

*“...in this situation it is **probably alright, because it was an OSCE**” (P#6)*

The fact that students perceived the simulated scenarios as OSCE stations implies that their observed thinking and behaviour resembles that of OSCEs more closely than their thinking and behaviour in real clinical practice. While there may well be overlap between these two, there are also significant differences that the students explicitly pointed out during the interviews. During the reflective interviews, they highlighted the aspects where their thinking and behaviour was altered by the contextual pressures, highlighting the ways the OSCE setting could influence students thinking and behaviour.

*“...You are **always sort of acting in a consultation**” (p#9)*

*“...I think it’s **hard, it’s hard when you are under pressure in that kind of situation, because you are probably acting a bit differently to how you would do in a normal consultation** if you weren’t in a, I know it’s not an exam, but if you weren’t in that kind of set-up. I think you probably would be a bit different.” (p#10)*

*“...I know it’s not like **appropriate and in front of a patient I would never ever do something like that**” (p#8)*

Students referred to their performance during the simulated consultation as “acting”, suggesting that their behaviour in real scenarios would be different. If the students’ behaviour is in fact different from their behaviour during real consultations, as indicated

by the present data, that calls into question the predictive power of these simulated consultations for future clinical performance. Both simulated practice and simulated examinations aim at providing a realistic training and assessment for future practice, however, these aims may not be met when students consciously change their behaviours in these settings.

### **5.3.1.1 Artificiality of the scenarios**

During the interviews, students often made reflective comments about the artificiality of OSCE scenarios. They perceived many features of OSCE consultations as different from those of real consultations. They had well defined ideas about what they are expected to do at certain OSCE stations and how OSCE actors would react in various situations. They would attempt to categorize and identify stations in order to know what is expected of them, which gave rise to station recognition instead of pattern recognition of illness scripts. Even during the Simulated Surgery consultations, students were often focusing on anticipated expectations instead of being immersed into the simulation.

*“...Like typically like **in an OSCE they usually have like a strong family history, and that’s kind of like what they are like pointing you towards**” (p#8)*

*“...And when he said pills like **it seems like a particular like OSCE situation where like they suggest medications, but they don’t know what it is, but on the mark sheet I am pretty sure they ask you to specifically know what the pills are**” (p#8)*

*“...when I was thinking COPD, I think smoking, it’s a really common cause, and **usually it’s really typical in an OSCE history**” (p#8)*

The simulated nature of the scenarios and their previous experiences with OSCEs meant that students knew a lot about standard OSCE stations and had strong expectations about how the consultations would unfold. They tend to recognize the OSCE targets during the simulation, and seem to know what to look for in the stations that they could get scores for on their assessment checklists. Of course, in a real clinical situation, such anticipation would not be feasible. Such predictability in the OSCE stations means students approach the stations with pre-set anticipations and expectations that guide their consultations. It influences the focus of their inquiry, and thereby influencing their diagnostic reasoning in a way that could be different from real scenarios.

*“...I couldn’t see anything wrong with the ECG, like I couldn’t see any changes that were concerning, that could sort of highlight that he was having a*

*myocardial infarction. But at that time, I was thinking, you know they gave me an ECG, surely there is something I need to find here, what am I missing?” (p#3)*

*“...I don't know why, but you just panic, like right, what equipment I have, I got to use immediately” (p#11)*

*“...I think in the real thing [i.e. real OSCE], what I am probably thinking is, okay, that's the ECG one done, what could it be next, it might be this, or this, or this...” (p#4)*

Even the props of the stations induced expectations in the students. When they were given an examination result, they expected to find something. When they were given props, they felt the need to use them during the consultation. Also, once finished with a station, they anticipated that the problem covered there will not be present again in the subsequent stations. These preconceived ideas would not be present in real situations as there would be no reason to anticipate such association.

*“...I guess in OSCEs you are kind of divided into two stations, you either have a medical patient where if you are going on the wrong track they just say no, no, no, no, and then see whether you get to the right track, or communication patients who talk as long as possible and then you are expected to steer them into the direction of something, so that's what I thought was difficult about the beginning of this patient ...The difficulty that I found with this patient was that I wasn't quite sure if this was a communication station or if it was a medical station, because of the length of the duration he was talking about irrelevant facts, I was subdued to what was going to happen” (p#8)*

*“...So I was kind of like in my mind try to work through as you would like as it was like an OSCE interpretation question, so like name, age, date of birth, time take, and confirm any details” (p#8)*

*“...in my mind I was like oh is this the station where you need to like educate them on the problems of antibiotics and you don't need to give them, so that's kind of like what, I think I was pre-primed to not wanting to give them” (p#8)*

Students described that there are different types of OSCE stations which require different approach. Some stations focus on diagnostic skills, while others focus on communication skills or interpretation of findings. During the Simulated Surgeries, students who treated the consultations as OSCE stations were consciously trying to judge which category of stations each consultation belonged to. They were trying to figure out which main competency they were expected to demonstrate at each station. This approach reflects a different type of problem solving compared to real consultations. The framing of the experience is different and their approach to the consultation is dependent on that framing. This way the students are using their

cognitive resources to categorize the stations and focus on demonstrating selected competencies, instead of taking on a whole-task approach as they would in a real consultation.

*“...often a patient in each of these stations has something that you need to make sure you have gotten out of them” (p#4)*

*“...So I think at that point I was wondering if later on in the consultation there might be something to do with negotiating him not going back to work” (p#6)*

*“...So you can see what he wanted to, I wanted to know what he was, what he wanted to get at now, like what is the extra thing they wanted to get out of you there” (p#7)*

*“...When he said like ‘oh I can run to a bus’, I was kind of thinking are they asking me to test about exercise tolerance or not” (p#8)*

Students thought often revolved around the expectations related to the various stations. Their comments reflected the perceived artificiality of the scenarios as they approached the stations as an exercise with set learning goals, instead of becoming immersed in the scenarios and treating them as real consultations. Their awareness of these learning goals and expectations also seemed to induce an external, third-party focus on the authority figures. At times students were preoccupied with trying to identify what “they” (i.e. their educators) wanted them to do, and fulfilling these expectations became the central motivation. This external focus carries the risk of directing their attention away from the patients’ priorities and hence could be interfering with empathizing and engaging in a patient centred approach.

*“...they are expecting you to specifically ask about a condition in an OSCE” (p#8)*

*“...I guess it is also different in a simulated surgery that I knew what they wanted of me in this scenario...I think they wanted of me some, you know he was going to tell me he wanted a scan, you didn’t want to give him a scan, and what sort of other management therapies you can think of for him which starts with physio basically” (p#7)*

*“...So like he kind of like pointed the medical student towards like a type of diagnosis, smoking related lung condition, I think they are expecting to piece together it’s COPD and just ask them” (p#8)*

With many stations, students seemed to be able to recognize the station and identify the specific learning goals they were expected to achieve. However, this takes away the uncertainty element that is often an inherent part of primary care consultations and may

also decrease students' engagement in analytic reasoning. Recognizing the station mimics the non-analytical cognitive strategy of pattern recognition, however, instead of accessing an illness script, they are recalling the tasks that are associated with a stereotypical station, including questions to ask, behaviours to demonstrate and management strategies to use. However, recalling those tasks can take place without necessarily engaging in diagnostic reasoning. Also, while focusing on the learning goals they thought their supervisors were expecting of them, at times they missed other important elements of the consultation.

*“...I found that bit really funny, because I think it just showed that he was an OSCE actor, cause he started giving me the pain scores out of ten which is something that students always ask, you always go, ‘how severe would you give it out of ten?’ which can be quite a I think like a rehearsed thing to say and it doesn't seem very human at times, so when he started..., ‘I would say today it's a 9 out of 10’, and then I was like ‘oh right, okay, you have done this before’. So that made it seem very OSCE as opposed to like real life situation.” (p#6)*

*“...Again, I already knew what he was going to say for this question” (p#7)*

*“...I felt like if it was in like a real OSCE situation, I would expect him to just say no and move on” (p#8)*

During the reflections, students commonly referred to the patients as “actors”, and they were contrasting how real patients would behave in such scenarios as opposed to the actors. Pointing out those differences indicated their conscious awareness of the simulated nature of the consultation and suggests low level of immersion in the simulation. Such differences also undermine the fidelity of the scenario and do not necessarily elicit the realistic behaviours from the students. Students also had set expectations about how OSCE actors usually behave during certain consultations and how they would answer certain questions. This decreases the fidelity of the simulation as it would not be realistic to be able to predict real patients' answers to their questions in such ways.

*“...I think as well, that this is, I was thinking like this is quite a simple history, I feel like I have missed something out. Turned out I did, I should have focused a bit more on the inhalers, but I was like what could it be or what is the learning point here, because I feel like I missed it a bit. It all felt a bit too simple, which isn't a good sign in an OSCE.” (p#6)*

*“...I think at this point I was like oh, now he is going to tell me the bit that's going to make it a little bit more complicated” (p#6)*

Students also had expectations about the complexity of OSCE stations. Therefore, when the station seemed too simple, they kept the enquiry going as they knew there was more to find out. This way their diagnostic enquiry was influenced by the anticipations about standard OSCE station complexity. This approach again would not transfer to real situations, as there is no standard complexity for real cases.

*“...I know for an exam, if it was actually supposed to be something blaringly obviously like he is having a heart attack, it probably would be blaringly obvious.” (p#6)*

*“...At least with these, there is definitely a clear answer, because they are all, you know, artificially written scenarios, but when you do get into like a proper practice, you might get situations where you do get patients where you do not have any idea what to do. And that’s kind of the scariest thing of it” (p#2)*

OSCE stations were expected to have a clear solution and unambiguous examination findings, unlike in real scenarios. The challenge in real primary care consultations is often exactly the ambiguity and vagueness of the information available for the clinicians. Students seemed to be aware of this discrepancy, and the anticipation of not being able to find an answer to real patients’ problems induced fear and anxiety in some students.

*Researcher: “Do you think you would ask for help if you were in a real situation?”*

*Student: “Yeah. I think, I would hope so. I hope I would, because I don’t think I would actually be happy about sending that man away...” (p#11)*

*“...when you are on your own you feel like, it’s just me and I can’t refer and I can’t ask for help in the GP, but you actually can, like even being an F2 going to speak to one of the more senior GPs about it if you are not sure what to do” (p#11)*

*“...Yes, and you just want to tell the patient, just can you just give me five minutes, I am just going to go to the other room, I just go Google and Wikipedia and look it up, and I come back and tell you exactly what you have got. But you cannot do that and that’s the problem. And when you can look up things and it is acceptable to look it up in some GP practices, because there is so much of medicine online nowadays that the patient kind of expects that you can look up stuff without having a loss of confidence, which perhaps was more before...It has to be done in kind of a collaborative manner.” (p#2)*

Another way that OSCE settings tend to differ from real practice is the lack of access to help. In real scenarios students can turn to their supervisors or online resources when they feel stuck, even when they work as doctors in their Foundation years. However,

during OSCEs or the Simulated Surgeries, students are naturally not allowed to ask for help or access online resources, in an attempt to promote independent practice.

### **5.3.1.2 Contextual pressures**

Students often made reflective comments about the perceived contextual pressures of the simulated consultations. These perceived contextual pressures were closely related to those that characterize OSCE consultations. The supervisor filling in a checklist, the peer observing them, and the strict time limit were all contextual factors highlighted by the participants that were increasing the pressure of the situation and interfering with their optimal performance.

#### *Performance anxiety*

During the reflective interviews, students implied that OSCEs are associated with high level of stress and anxiety. Due to the perception of the Simulated Surgeries as mock OSCEs, most participants also experienced heightened level of anxiety during the simulated consultations, despite the fact that the Simulated Surgeries do not form part of the students' summative assessment.

***“...when you get the anxiety associated with an OSCE means that you do not perform as well, and so I think what simulated surgery is doing is trying to normalize the whole situation...if you can reduce the anxiety when you go into an OSCE eventually you will hopefully perform better. So, I find it really helpful”***  
(p#4)

***“...That's why you have to practice so much for the OSCEs, so that it becomes like a routine, otherwise even something as simple as looking at a urine dipstick is completely horrible”*** (p#2)

Students suggested that when their anxiety levels are too high during OSCEs, their performance can struggle. However, with extensive practice, the exam situation can be normalized as the tasks become routine, which in turn can lead to improved performance. This suggests that their performance anxiety interferes more with tasks that require higher cognitive functions as opposed to routine tasks.

***“...You can see that I am blinking a lot, I am nervous, because I really don't know where I am going and I forgot my, I don't have my like my train of thoughts, I have completely lost it”*** (p#5)

***“...But I was a little bit panicky, I was like, I have no idea. I'll explain it a bit and then I think I was also thinking about how should I come across to the patient, cause if I have no idea, what do I then say”*** (P#6)

*“...I think I didn’t really hear his questions, because I was still panicking about the ECG, yeah.” (p#6)*

Experiencing high level anxiety sometimes interfered with their cognitive functions, such as their listening skills and distracted the students, perhaps by momentarily increasing the cognitive load of the task. Students mentioned losing their train of thoughts and not knowing what to do next during the consultation as a result of their anxiety.

*“...I feel like I have to keep going doing something, even though I would really like to kind of be like, please would you help me, I am really stuck. So you just work with what you have then and there and what your brain is kind of doing, and just kind of keep going I guess...” (p#11)*

*“...you can’t even sit there in silence for a minute, you just have to do something. And, yeah I think that is the worst bit of it.” (p#2)*

*“...I always find it quite hard, especially I can see there that, when I am trying to think of a question, I don’t want to leave too long of a silence, because it makes you seem like you don’t know what you want to ask, but that is true, so I start talking and I start changing what I am trying to say” (p#8)*

*“...They always teach us that silence is actually more helpful than saying anything else, and that’s probably true” (p#9)*

The perceived pressure of the situation meant that students felt the constant need to do or say something. Some students also expressed feelings of helplessness during the scenarios, whereby they feel unable to ask for help even though they wanted to. They feel like they cannot stop and think, or stay silent as that could be a sign of incompetence in the eye of the observers, despite their awareness of the potential usefulness of keeping moments of silence during consultations. Not being able to pause and think also means that they are trying to think and talk at the same time, which they find challenging.

*“...But that’s the thing, I am not very confident with the OSCEs at the moment. So I am working on that...if I am with a patient like in general practice what happens is at my GP placement, I go into a room take a history from the patient, I am absolutely fine. I think it’s just the fact that now I am being assessed on what I am doing. And I had like really positive feedback from my GP, so I think it is just being in an exam situation.” (p#3)*

*“...So, to be honest, in a GP practice, I am actually I am more calm” (p#5)*

It was suggested that it wasn't the consultation itself that made students anxious, rather it was the examination nature of the situation that brought on the anxiety. Some students explained that they feel much more relaxed when they are performing their tasks during real clinical scenarios. However, it is important to keep in mind that at this stage of their training, their real clinical duties only involve history taking without diagnostic responsibilities. Therefore, it may be the combination of the contextual examination pressures and the added new responsibility of diagnosis and management that elevates their anxiety levels.

*Researcher: "What brings on the pressure in this situation?"*

*Student: "Umm, I think the fact that you know that there is **someone there scoring you**, the fact that you have a **partner** probably adds pressure, and the fact that you know that you gonna have to do this, although this is a practice, **the fact that you know that you are gonna have to do it for real...while I think once you have passed everything you would be a bit more relaxed about it.**" (p#10)*

*"...Um, I am just thinking that I need to, if I am really honest, I feel like I need to **do better than I did in the first station**, and also **because this is my facilitator**, and I am like, **I want to do well to show him that I am capable**. So yeah, I feel a **little bit pressured**, and maybe a **little bit distracted** as well." (p#5)*

*"...And I was **seeing my facilitator smiling**, oh gosh, **I felt so bad.**" (p#5)*

When asked about the perceived pressure during the Simulated Surgeries, students listed being assessed by the supervisors, having a desire to appear competent in front of their supervisors, and being observed by their peers as the main contributing factors. Even though the simulation did not involve formal assessment, the supervisors were filling out a feedback checklist during the consultation that resembled assessment checklists, and many students perceived this as being judged and assessed during the consultations. Also, the student pair, the simulated patient, and the supervisor were all sitting by the same table during the consultation, which meant that they were all in sight of the student leading the consultations throughout the entire time. Seeing the supervisor's non-verbal reaction during the simulation was at times distracting for students, especially because students found it important to appear competent in front of the supervisors, who were also their GP placement supervisors.

*"...I go into this almost like a **fight-or-flight mode**, where I'm just like go, whenever I see something, and I'm like, even if I know it, and **I think I might know it if I calm my nerves down**, I go like '**no, I don't know it, let's just end this**' and I disguise it a little bit better than before, because before you could just really see me flush, but still" (p#5)*

*Researcher: "How did you feel being filmed?"*

*Student: "I actually forgot that...Because it (i.e. the camera) was on the side, it wasn't there (pointing ahead), so I couldn't see it and also the good thing was you weren't anywhere in the zoom, so I forgot that you also were there" (p#5)*

One participant described that the level of anxiety at times can be so high that it induces a 'fight or flight' response, whereby the student is desperate to escape the situation. Such high level of anxiety is not advantageous in simulated practice simulated as it interferes with the learning experience. On the other hand, when asked about being filmed during the consultations and having the researcher in the room, all participants agreed that it did not elevate their anxiety levels. One reason for this was that both the camera and the researcher were out of sight during the consultations, which made the participants forget about being filmed. This suggests that where the observer is placed in the room can influence their effect on the students' anxiety levels.

*"...Yeah, sometimes I think sometimes you do feel more confident if you just decide what you are going to go for, and then at least it looks like you are doing clinical reasoning and you know your diagnosis" (p#1)*

*"...it makes you feel a bit better, because you have covered up your mistakes" (p#1)*

*"...I was just thinking to keep asking questions to make it look like you know what you are doing. But I guess that is just not clinical reasoning, if I haven't had anything in my mind to like direct my thoughts." (p#1)*

*"...I think it was nice that everyone said that I was confident, because inside I do not feel confident any way at all, so as long as I come across as confident I guess it is half of the battle really (p#2)*

The perceived pressure and desire to appear competent meant that students at times were consciously disguising their weaknesses during the consultations. They thought that giving the appearance of clinical reasoning and covering up their mistakes during the consultations would give the illusion of competence.

*"...So, to be honest, in a GP practice, I am actually I am more calm, because I think because I know it's a real patient, and they even though if I even don't understand anything of what they are saying, I am pretending I do, because I feel like they come there, and they don't want to see someone that don't understand anything or don't know what they are talking about, so I try to act more competent, and you know, be more focused as well" (p#5)*

One participant even admitted keeping on the pretended competence when she is seeing real patients as she does not want to be perceived as incompetent by the patients. She

seems to have a perception of doctors as being competent at all times and having a good understanding of the patients' problems. She does not seem to consider uncertainty and inability to diagnose patients as part of a doctors' identity.

*"...although you are under pressure, you are not under as much pressure as in the OSCE" (p#2)*

*"...Generally okay, in my feeling, we have done this quite a lot, the acting, and especially the Simulated Surgeries, **this is the third session of the year now, so I actually find it relatively I am able to focus on the patient themselves, so I am thinking quite a lot about what they are saying to me, so it is okay for them to come along.**" (p#12)*

*"...it was fine, yeah, **I don't really get that bothered by them [i.e. the Simulated Surgeries], because we have done lots of OSCEs now, and I know that I am not getting examined, it's purely for learning so**" (p#6)*

Finally, students who were conscious of the fact that they are not being assessed and interpreted the situation as non-threatening did not find the Simulated Surgery consultations as stressful as the OSCEs. These perceptions highlight the importance of idiosyncratic interpretation of the context. Their account also suggests that with increasing practice, their anxiety reduces and it becomes easier to focus their attention on the patient. However, even the students who claimed to be less anxious have shown momentary signs of anxiety during the consultations.

#### *Time pressure*

The Simulated Surgeries had strict time limits, which was aimed at preparing the students for the time restrictions in general practice and also for the time pressures of the OSCEs. However, often students found it difficult to adjust to this time limit and felt rushed during the consultations.

*"...I think the **timing is really hard**" (P#4)*

*"... I thought it was panic attacks, but **I didn't know about other differentials, other things, and I didn't think I had enough time to think of those things, so I just ploughed on with my one differential that I had**" (p#7)*

*"...I mean I felt like **it was kind of pressured, because it was kind of like a five minute station in itself, because like if you wanted to do a full interpretation of an ECG, so be like calibration, checking each of the waves, time intervals, axes, deviation, you can't really do that in about 30 seconds that was given, so like I was kind of looking for any like quick, immediate, jumping out of the page type of things, although I realize it is probably not the best doing that at the moment**" (p#8)*

Experiencing difficulties with adjusting to the time limit meant that students were sometimes in a hurry to cover everything they were supposed to cover during the consultations. In some cases, they found that they would have needed longer time to complete the consultation. They found it difficult to consider all the differentials due to the time pressure. They also found the time limit of the consultation too short to systematically go through the interpretation of some test results.

*“probably if I had lots of time I would be able to almost like write out what I needed to do and really think about that” (p#10)*

*“...you are so time pressured, you can't really think clearly and...you are only just learning the medical stuff...and then you have got the kind of time pressure to try and remember all anyway, so I would say time is a problem, you just haven't done it enough to be able to do it quickly” (P#10)*

One reason why the time pressure of the consultations was found challenging was that the students have just learned the medical facts, and therefore they find it difficult to apply it as quickly as they are expected to do during some of the simulated stations. One student described that given enough time, she would “write out” her diagnostic process, which implies the use of analytic reasoning strategies, but the time pressure did not allow her to go through that analytic thinking process. However, given that pattern recognition is not yet largely part of their repertoire, analytic strategies are the only ones they can rely on. Therefore, such limited time pressure does not take into account that the students current stage of diagnostic reasoning development.

*“...I think, it's difficult, because obviously in GP they only have ten minutes, but really if you need to give a person 15 minutes, in my mind, you give them 15 minutes... it's difficult, because in a real life situation I would have given it more time probably” (P#4)*

*“...in GP surgeries, I have to do actual consultations, there I have a bit more time to think, a bit more leeway” (p#7)*

Students recognized that in real clinical practice they have more flexibility with regards to timing. They generally have longer time to think about the clinical problems which they perceive as helpful. They also realize that in real practice, they can use their judgement on whether they need to give a patient a few more minutes of consultation time when necessary. Learning and practicing such judgements are important and could help them prepare them for real practice.

### 5.3.1.3 Lack of reasoning and ticking boxes

Due to the artificiality of the setting, the perceived assessment element and time pressure of the Simulated Surgeries, students were often seen altering their behaviour to suit the setting. One way the students' behaviour was altered during the consultations was asking questions they would not normally ask in a real clinical scenario.

*"...So at the end of this I was like, I am pretty sure it is a urinary tract infection, and then I was going for the sexual health screen, and **that was more because I thought that would be a mark on the sheet, like for my own diagnosis I didn't think I need to ask these questions**" (p#1)*

*"...in real life I don't think you would ask the questions about suicide, but in an exam situation you should" (p#7)*

*"...So I kind of didn't want to directly say like 'do you know how to use your inhalers?', but I just thought in an OSCE it would be a useful thing just to say" (p#8)*

*"... 'have you ever thought about ending your life or hurting yourself?' ... I suppose yeah **that's more like an OSCE box**" (p#4)*

It was apparent from the students' reflections that they perceived certain questions as "OSCE boxes", which meant they felt obliged to ask them in an OSCE setting, but did not perceive them as necessary to ask in real scenarios. Students admitted asking these OSCE-box questions even when they did not consider them diagnostically relevant in an attempt to get a higher score on their assessment checklist. However, this discrepancy means that deducing diagnostic skills from the questions that are being asked during these consultations would be misleading as they do not truly reflect the students' diagnostic reasoning.

*"...The green phlegm I think was **the hint** for me that it was a bacterial infection. But it didn't really clock, because I was on a roll, so to speak, I was just thinking I need to ask this, ask this, ask this, so I wasn't really putting everything he was telling me together at the time. I think because kind of because of the pressure and I am thinking I need to tick some boxes. Like in the yeah I am thinking I need to ask this, I need to ask this, so sometimes I am not necessarily processing the information that I am getting." (p#3)*

*"...I think I kind of already knew what the problem was, so I was just doing that to tick boxes rather than to actually make it more the diagnosis I think" (p#6)*

*"...and sometimes with OSCEs, it is not really testing diagnostic skills, it is testing the fact that you have learned a list of all the different stations that could possibly come up and you have seen all these things, like I am sure I could get full marks on these stations because I would have made one of these*

*[i.e. station evaluation checklist] myself before I would have checked it. And that is good in a way for learning, but it is not good for like the diagnostic thinking, 'cause then it's just like an exercise, like a planned exercise" (p#2)*

Being preoccupied with ticking boxes while also trying to adjust to the time limit of the consultations, students sometimes rattled through the list of memorized questions without processing the information they received for those questions. By asking questions in quick succession, they just accumulated information instead of piecing it all together at the time. This indicates that their priority was asking the questions instead of using the information to guide their diagnostic thinking. Getting through these questions often seemed to be separate from the diagnostic process itself. Ticking the boxes continued even when students thought they have already identified the correct diagnosis and when they saw no real use for further questions. This type of behaviour reflects a pure memory recall exercise instead of opportunity for diagnostic thinking. Alarming, it was claimed that they could get full marks on their examinations just by memorizing the stations checklists without utilizing much reasoning and critical thinking.

*"...I got onto those key, closed, red-flag questions, all the key questions you are supposed to ask I memorized for my exams..." (p#7)*

*"... before the OSCE you have all these rehearsed lines, and I write it down, and I have a script I have to admit" (p#5)*

*"...So right, at this point when he said that something had happened in his family I have kind of ignored the point, ticked it off in my mind and then moved on to the next thing. I know it's not like appropriate and in front of a patient I would never ever do something like that, it's just in mind I already kind of like confirmed risk factors for an MI" (p#8)*

Some students prepare for the OSCEs by memorizing checklists they are supposed to ask for certain stations. When at the stations, they want to get through those questions quickly, sometimes without actually listening to the answers to those questions as they are getting a score for asking each of those questions and not for explaining how the answer is relevant. Once they tick off something in their list, they move on to the next question, sometimes without engaging with the patient any further. However, they do realize that this kind of approach is not appropriate in real clinical practice and they claim they would not use this approach in real practice.

*"... so, usually for the OSCEs, because we practice so much, I usually have a set of questions whenever they have a certain kind of disorder, like a mental disorder, the set of questions that you need to ask. At this point, because I am very out of practice, I am trying to remember the questions...At the same time, I*

*want to make it natural, and not just tick boxes, which I tend to do when I am in the OSCEs, you just kind of almost feels like you are not listening to the information that is given you, you just want to get all the ticks...” (p#5)*

*“... my first GP visit, when I came in with my kind of tick-box kind of way of asking questions, and you have a **real patient**, because another thing is **real patient is different from an OSCE patient**. A real patient has a lot of other things to talk about, and what you think is important is might not be what they think it is, so you have to kind of let go of that control and see where they want to go first. Because when I try that first, asking them a set of questions, **you might almost offend people** by like you know **you feel like you are overrunning them with your questions**, and so I try to kind of let go of that a little bit.” (p#5)*

This discrepancy between their behaviour in real clinical practice and OSCEs again questions the predictive power of such simulated assessments. The participant above expressed a desire to be less rigid during their consultation and avoid the strict tick boxing style of questioning, which meant at times she was in a dilemma on how to approach their simulated exercise. She also felt like that the approach that best suits an OSCE consultation would be overwhelming for a real patient. However, this implies that when they transition into real practice, they need to learn a new approach to consultations that would better suit that setting.

### **5.3.2 Diagnostic reasoning**

The first superordinate theme showed that there are many expectations and contextual pressures associated with OSCE consultations that can influence medicals students' cognition and behaviours. At times these pressures lead to the momentary suppression of all reasoning attempts in favour of ticking boxes. However, this is not to say that students do not engage in any diagnostic reasoning at all during simulated or real consultations. The second superordinate theme describes what characterizes their diagnostic approach when students do actually engage in diagnostic reasoning. As the setting of the Simulated Surgeries resembled a primary care context, these reflections and interpretations portray students attempt to solve diagnostic problems in primary care. Due to the OSCE-like feature of the setting though, it is difficult to decide whether these cognitive strategies are equivalent to those that students would engage in if placed in a real clinical scenario. However, as this theme will reveal, students at this stage of their training do not yet have experience with taking on the leading role in diagnostic consultations. These simulated consultations form part of their first attempts to actively engage in and rely on their diagnostic reasoning, formulate a diagnosis and manage patients. When trying to disentangle how they would reason in a real scenario from how

they would reason in an OSCE scenario, the present analysis relied primarily on the students' own interpretations and judgements of how contextual pressures influenced their cognitions and behaviours.

### **5.3.2.1 Generating initial list of differentials**

Before entering the consultation room, students were instructed to read the station's notes that included the first clues about the patient they were about to see. These notes generally included a brief description of the presenting complaints of the patient supplemented with some basic examination findings or test results. Upon reading these notes, students said that they started to generate initial diagnostic ideas and anticipations about the upcoming consultation.

*Student: "... the station information, I can't remember exactly what it said, but it gave me a bit of information, it said he had testicular lump, so at that point I was trying to think of okay, what testicular lumps do I know, and so there is obviously cancer, um there is varicose veins in the testicle and epidermal cyst, just had three just in my head to have a think about, just so that you know.*

*Researcher: "So already differentials in your head?"*

*Student: "Yeah, I try to do that, and that sort of thing I have tried to do in year three with our OSCEs, I just found it useful because when you needed to focus in, if you haven't been given anything from the history you had something to get back to" (p#12)*

*Student: "So this woman, so the thing about her is that on her sheet on the door, it says she has chest pain and then her examination is normal. And so if you have a young person who has chest pain and the examination is normal, usually it kind of goes, okay this might be more related to talking about psychosomatic symptoms, just generally in my head. I mean it shouldn't immediately go that way because you should keep yourself open to potentially it being like a hereditary condition involved in the electricity of the heart, but I think just generally it's quite like a, because they come to the GP they aren't going to A&E so I am already thinking okay this potentially might be you know psychosomatic."*

*Researcher: "Do you think you kept your mind open though?"*

*Student: "It's interesting that you mention that, I probably did close it off a little bit" (p#4)*

Some students were coming up with differentials as soon as they read the presenting complaint in the patient notes. They felt that having differentials in mind early on helped them to be more focused during the consultations from the beginning, and it increased their sense of confidence. Collecting information with a diagnosis in mind resembles a backward reasoning strategy, also referred to as hypothesis testing. One student mentioned how having differentials in mind based on the presenting complaints

could be especially helpful when the history does not reveal much diagnostically useful information, as they can fall back on these initial ideas. However, this approach also carries the risk of anchoring bias, when students rely heavily on the first pieces of information during the diagnostic process. However, participants did not show awareness to such bias, nor did they mention any de-biasing strategies to avoid them.

*“...Now I was like, diarrhoea, so you are thinking, ‘what do I think?’ **You are trying to think all the infectious stuff, and then like I don’t know, you are trying to think about anything that it could be, you have to remember to ask all the things, all the bowel stuff that I may have forgotten like Crohn’s, that kind of thing.**” (p#1)*

*“**. . .it could be panic, it could be panic disorder, it could be depression, it could be manic**” (#5)*

*“...I was **desperately trying to think of any kind of differentials**” (p#11)*

*“**. . .I should be thinking of a lot of differentials**” (p#10)*

Once the consultation began, students were trying to generate a list of relevant differentials based on the patient’s problems. This initial search for relevant differentials was often initially based on a single sign or symptom that was seen as the chief complaint. Students were trying to generate a broad range of differentials, trying to think of “*anything it could be*”. Their thinking at this point did not seem to involve any cognitive strategies or attempts to narrow down this initial search for differentials. However, since the list of differentials based on a single symptom in primary care could be very extensive, this exhaustive approach could be challenging.

*“...So just looking for the **common causes of what might cause sudden onset diarrhoea, so changes in food and whether he had travelled, he might have been somewhere else, he said he wants to back in Manchester so he might have been somewhere else**” (p#2)*

*Student to the patient: “It looks like that you have had some sort of **an acute cardiac event**”*

*Student’s reflection: “**I said like acute, but it could have been like acute or chronic sort of cardiac picture**” (p#8)*

A somewhat more complex approach was demonstrated when the working diagnosis was generated based on the presenting complaint and its onset. The student in the first extract was not looking at the presenting complaint in complete isolation but considered the time course of the symptom as a semantic qualifier that could reduce the number of relevant differentials. Making use of semantic qualifiers in diagnostic reasoning is

indicative of a forward reasoning technique. However, the expression of ‘semantic qualifier’ wasn’t explicitly mentioned by any of the participants, which may suggest the participants’ lack of conscious awareness for such cognitive strategy. Also, caution needs to be taken when deducing the use of semantic qualifiers based purely on linguistic markers alone, as students sometimes admit using these terms such as “acute” or “chronic”, without corresponding knowledge of diagnostic relevance, as demonstrated in the second extract.

*“...I had **no particular diagnostic ideas**, I just wanted to then explore lots of different things” (P#7)*

*Researcher: “So did you have those differentials, did you have them at the beginning in your mind?”*

*Student: “I think **I should have done**, it would have been better if I have done, but I don’t think I had here at all, **I don’t think I really knew what I was doing before I got started**, and then as we got started I was **thinking up more as we went along**” (p#10)*

At times students were struggling to generate a list of differentials based on the presenting complaints. Not having a working diagnosis at the start and having to think of differentials as the consultation was progressing was perceived as a less effective diagnostic approach, which indicates that students were more comfortable with hypothesis testing as opposed to the forward reasoning.

*“...I really couldn’t think of anything else, what it could be, and that would have really helped if I had a little bit more knowledge again.” (p#6)*

*“...So I had a good idea about what I was going to say, or what I thought was going on, so I thought it was panic attacks, but I didn’t know about other differentials, other things, and I didn’t think I had enough time to think of those things, so I just ploughed on with my one differential that I had and because I was, to me it was most likely and sort of babbled on that while trying to think about other things, which just didn’t help” (p#7)*

*“...I was just rattling on things I knew about panic attacks and general anxiety disorders at this point, but I sort of you know lost what I wanted to do which was trying to think other things, but at this point I was like okay just plough on with what I know already” (p#7)*

At other times, students only had one single diagnostic idea based on the presenting complaints. Due to the time pressure of the consultations, they found it difficult to spend sufficient time thinking about further differentials. However, this meant that they maintained the original diagnostic idea despite their awareness that other differentials should be considered. When their original working diagnosis was indeed the right

diagnosis, this approach was perceived by the observers as a confident, competent and focused diagnostic approach, while disguising the fact that the student could not name any other differentials relating to the symptoms.

*“...I think one was a bit better, because **I was more confident**, like discussing and I already **had a few more differentials in my head**, so I was a **bit more comfortable** going on, **while in the other stations**, it’s like sometimes it’s been a few years, and **I have minimal knowledge about it** anyway, because I haven’t had a lecture or haven’t had a rotation about it yet, so **obviously I am not going to be as good** as in this one. I felt confident with this, because it is a topic that has been covered ever since two or three years so yeah ...**more knowledge of the topic, definitely equips you to be able to do the differentials** and the management plans as well.” (p#2)*

*“...my knowledge is at that point where **I am not great at thinking up a list of differentials**” (p#6)*

*“...And again like in my thing she said, she has written like what you know about anxiety, I need to ask about anxiety, but **I have just done my rotation on neurology**, and **I am worried that if she has fainted then she could have fallen, knocked her head**, and all that stuff, so **it’s funny how that happens when you are in one rotation how your practice changes.**” (p#4)*

*“...At this point I was desperately trying to think of any kind of differentials. **Because I have not done ophthalmology, I was thinking more neurology** a bit, so I think I was **trying to screen there for migraines** maybe or something like that, or maybe even **temporal arthritis**” (p#11)*

Having more domain knowledge was associated with better ability to generate the list of differentials based on the chief complaint. Having limited domain knowledge due to a lack of domain specific lectures or recent clinical rotation restricts their ability to generate differentials and initiate the diagnostic process. At times, recent rotations also influenced the group of differentials they generated. Although some students recognized this heuristic (i.e. recency effect), they did not express concerns over the possibility of this leading to availability bias.

### ***5.3.2.2 Narrowing down the differentials***

The diagnostic refinement process often started with linking the presenting complaint to the most likely system involved. Students tried to narrow down the possibility of differentials by trying to identify the most likely system involved based on the presenting complaint. Some were using an anatomical approach whereby they identified the system in closest vicinity of the presenting complaint.

*“...Yeah, so it’s cough and something respiratory, and since he mentioned chest problems I was thinking COPD, so I will need to come back to that just to check it out later” (p#9)*

*“...So first of all, I would be wanting to know what is the patient coming in with, so when they tell me the first thing they told me oh I am having a cough immediately I am like oh this is respiratory. I have already kind of grouped it into so I am going to explore like a respiratory related symptoms that’s what I was thinking” (p#3)*

*“...in mind I have got this sort of set of respiratory questions I need to ask in a respiratory problem, and so just running through those” (p#9)*

Categorizing the presenting complaint into a broader system (i.e. cardiovascular, respiratory, or GI) helped the student focus their diagnostic search. Identifying the system involved helped to guide their questions about associated symptoms. Although narrowing down diagnostic ideas is essential during the diagnostic process, only focusing on the most obvious system may carry the risk of missed diagnosis. In real practice, the same symptom could indicate the involvement of many different systems in different cases.

*“...heart failure can cause the breathing problems as well...Yeah, so that’s the important question, just, you know, have I definitely got this right? Is it definitely respiratory, or is there something else that’s bothering him, so that’s a very much ruling out questions, and confirming that I am on the right lines” (p#9)*

*“...The problem is when the patient start mentioning exercise tolerance, and they have some sort of like lung pathology, I like to think it’s because of like some sort of like cardiac cause, could it be some sort of like heart failure, rather than a sort of like respiratory caused disease” (p#8)*

*“...I didn’t really do like an effective systems review so any problems with bowels, waterworks, any faints, dizziness, funny turns, probably would have been more appropriate” (p#8)*

Although their first associations were often linked with the most obvious system involvement, some student demonstrated conscious awareness that making such initial judgements based on limited information can mislead the diagnostic process. They found it important to check the potential involvement of multiple systems before concluding the final diagnosis.

*“...I think here I was now trying to just like try to see whether it was an acute myocardial infarction or it was an acute coronary syndrome.” (p#3)*

*“...I kind of wanted to know like was it asthma, did he have some sort of infection and they were just trying to like dilate his airways in the past, if the*

*infection has been a problem, or is he suffering something long term like sort of like a COPD picture” (p#8)*

*“...I kind of wanted to know if this was something like unstable angina or if it was just angina at the moment, because he just walked to the surgery, or if there was actually an MI or not” (p#8)*

*“...this woman has anxiety, and so in my mind the depression and suicide questions weren't immediately there in my head, because she has got a different condition, she has got anxiety which I don't immediately link to depression and suicide, but actually, when I got the mark-scheme, I realized that those were the two things that I was meant to have done.” (p#4)*

In search for the right diagnosis, students were often considering two or more differentials simultaneously. One commonly used diagnostic strategy was having two or more differentials in mind simultaneously and trying to decide which one was most likely based on the patients' signs and symptoms. This strategy requires the knowledge and use of discriminating features, which the students sometimes struggled with. Also, their reasoning process reflected an “either/or” approach, whereby they were considering one differential over another, rather than considering the possibility of co-morbidity.

### **5.3.2.3 Relying on memorized lists**

Throughout the consultations, students seemed to be relying on several different memorized lists to guide their consultations. Some of these were used for data gathering purposes while others were utilized for hypothesis testing during the diagnostic process. While the checklists helped the students to remember relevant information, there were some challenges associated with their use.

## **EXPLORING PRESENTING COMPLAINTS THROUGH MEMORIZED LISTS**

The traditional history structure appeared as the first memorized list students heavily relied on during the consultation. The students' history taking was systematic, following the same traditional consultation structure each time. They started with introducing themselves to the patient and stating their role, then confirming the name and age of the patient, identifying and exploring the chief complaint, asking about past medical history and drug history, and finally covering family history, social history, and drug allergies.

*“...So pretty much I think **I am going through the same structured history** up to this point, partly, mostly because in most situations I do try to go through it, **because we have time pressure** as well when you are in a GP practice, so that's what's interesting, **a structured way.**” (p#2)*

*“...So I think there I have just noticed I was quite kind of like what do I ask next, and I was **just going back to the structure, we’ve always been taught in terms of like things you need to remember, drug history, allergies, family history, and kind of the social history**, so this bit doesn’t feel as natural yet, because I think I kind of **already knew what the problem was, so I was just doing that to tick boxes rather than to actually make it more the diagnosis I think**” (p#6)*

*“...So at that point, **I was thinking, I should ask his occupation, because otherwise I’ll forget** and I have done some previous clinics where they have been like ‘always as their occupation’, **so that is not something that came naturally**, that was something that I was like yeah, I need to do that.” (p#6)*

Students seemed to be confident using the same standardized history structure each time. It helped them deal with the time pressure of the consultations, to ensure they cover all the main parts of the patient’s general history. However, their accounts suggest that they felt obliged to complete the history regardless of whether they considered all the information necessary. At times they only completed the history in order to achieve higher scores on their assessment checklist.

*“...**I am the first person to see them, I am clerking a patient in**, you know, I know that **it’s so important to cover everything**, so that when you then describing them to the doctor you see” (p#4)*

*“...**I am still at the mode of like you know make sure you know your history and can take history properly and then the management is someone else is going to do that**” (p#5)*

*“...**we practice histories** and I feel quite okay talking to somebody, and asking questions and talking about it and discussing it, **but coming to a decision is difficult**” (p#11)*

Students had much experience with history taking during their training, predominantly in secondary care placements. When history taking was their sole task during those clinical placements, their priority was to collect all the available information they can from the patient through exhaustive and structured history taking. In these previous experiences, they were not the ones responsible for the diagnosis and management of the patients’ problems. Therefore, up to this point in their training, history taking was largely perceived as a separate process from diagnosis and management. This meant that students were used to taking history without thinking forward about the diagnostic implications of the information being collected during history taking. When given the new responsibility of managing the patient’s problems during these simulated consultations, students often found it challenging to make the transition from history to diagnosis and management. This transition also entailed a change from exhaustive and

thorough history taking to brief history taking that is directed and focused by diagnostic reasoning.

*Researcher: "So why were you asking the question?"*

*Student: "Because with the sort of, you know the **pain SOCRATES** questions, it's a format and sometimes you can see the value, like site, onset, time they are all really important, because you know they can give you different information and so can associated symptoms, what makes it worse, what makes it better, but what makes it worse I always thought was if say you have abdominal pain and some people say oh yes you know leaning forward or leaning back, but **it never seems to correlate with the actual symptom** like you know, supposedly leaning forward make some pains worse, leaning back makes some pains worse, but pain is pain, people find it painful still, so **I've never really seen that the actual questions of when is the pain worse all that useful**" (p#7)*

*"...I guess **I knew that these are the questions I need to ask, but I didn't know the value of some of these questions**, like anything make it better, yes, you know medication stuff, anything make it worse, I don't, I guess I didn't really know the value of it" (p#7)*

Students also used mnemonic devices to aid their memory recall of relevant questions when exploring presenting complaints. The most commonly mentioned mnemonic device that students used was the SOCRATES to explore pain symptoms. This mnemonic device stands for **S**ite, **C**haracter, **R**adiation, **A**ssociations, **T**ime course, **E**xacerbating and **R**elieving factors, and **S**everity. The value of the mnemonic lies in the fact that each answer could be used to contribute to the diagnostic process. During the interviews it became clear that students often used the SOCRATES during the consultations. However, often it was used, at least partly, as an information gathering tool rather than a diagnostic aid. Students admitted not being aware of the value of certain questions in the SOCRATES mnemonic. When they are unaware of the diagnostic value of such questions that renders the mnemonic to be less useful in the diagnostic process.

*"...I think I was **trying to screen there for migraines** maybe or something like that, or **maybe even temporal arthritis**, although I **then didn't ask any questions related to temporal arthritis**, the only thing I really asked I think was about nausea and vomiting, which I was kind of thinking about migraine, but **um it was just a bit floundering, trying to think of what to ask next**. So I think that when it comes back again to pain, I [...] a little bit, and I think I was like **right now I can do my SOCRATES**, and I can do my like, although then I **didn't even do that full**, because I didn't even ask about severity of the pain, it was just brought up, so it's interesting when you are in there, **you kind of get distracted, and go off on different pathways.**" (p#11)*

*"... I felt like I knew where I was going, but then I **side-track**, and we are going to see that later, and when I side-track I **completely blank and forget all my***

*questions, because I kind of I feel like sometimes my problem is, I am not assertive enough in my consultation, like I am not really taking control, I am letting go a lot of the control and what happens is that all of a sudden we start talking about something else and I can't come back to where I was, and I end up forgetting where we were going.*" (p#5)

*"...This is like, often what I do is that I have got like SOCRATES out, SOCRATES is what they use for pain, but what I'll do is I ask, I'll use that as like a sign post, so I like start, I ask where exactly is the pain, that's site, and then I ask, but it's not as concrete as saying okay I have to ask about this now, I have to ask about this now, it's more sort of I'll use it, it's more sort of a guiding tool, rather than first year OSCE, I must do that, that, that, do you see what I mean? It's more of a guidance rather than, so I go off and then I come back again, so the fear is have you made sure you ticked all those things off whilst still trying to be fluid."* (p#4)

One challenge that can arise when using mnemonics was that students at times got distracted and covered only part of the questions. They mentioned that it can be difficult to go through all the questions at once as the patient may bring up a different topic during that time which can be distracting for students. Also, one participant mentioned that she is trying to use the lists as a sign-post rather than asking all the questions at once. However, when the list is not followed through, they can find it difficult to return to the previous list and make sure they covered all the different items on it.

### **HYPOTHESIS TESTING BASED ON MEMORIZED LISTS**

One of the common diagnostic strategies used by the students was testing their diagnostic hypotheses against memorized lists of signs, symptoms, risk factors, and red flag questions associated with the condition in mind. This type of backward reasoning strategy was most prominent during the consultations.

*"...there are some key questions that you have to ask ... to determine whether they are likely to have depression"* (p#4)

*"...So that's like the depression questions.... There are like two screening questions that you do."* (p#4)

*"... just before I asked how her appetite was I realised that I said, I got into a roll of questions that I remembered suddenly, cause the ones that I memorized for my third year exams, it all came back and then rattled through some, appetite, sleep, mood, all that"* (p#7)

*"...Like I know I should have beforehand, you should have go to the symptoms and you should go through kind of like a systematic approach what symptoms should be"* (p#8)

When students came up with a diagnostic idea, they had a tendency to go through a list of memorized questions associated with that diagnosis in a systematic way. This approach reflects looking for confirmation instead of falsification for their differentials. One participant explained how they prepare for exams by memorizing such lists of key questions that they are supposed to ask for certain conditions. Their diagnostic strategy this way was congruent with their assessments, both largely based on whether they can recall a list of relevant questions. Remembering the relevant questions was associated with increased confidence as it meant scoring on the assessment checklist and being able to proceed with the diagnostic process. However, there was no mention of atypical symptom presentations and their implications for the diagnostic process. At this early stage of diagnostic skill development, students were most concerned with acquiring the basic knowledge relating to typical symptom presentations.

*“ . . . I think I need to develop my skills, in terms of, here is the list of questions I need to ask for a particular condition, and I need to remember all those screening questions...” (p#2)*

*“...So, I think I'll learn what, essentially I want to learn what symptoms I want to ask about, ask about a vague questions about anything else, and then do the rest of the sort of past medical history, family history, drug history, etc.” (p#9)*

Students recognized that at times they did not possess the knowledge of all the relevant signs and symptoms associated with certain differentials. Such knowledge gaps restrict the diagnostic capabilities of the students, as having such basic knowledge is a necessary prerequisite for sound diagnostic reasoning. Students expressed that it was their learning goal for the future to memorize such lists of signs and symptoms for each condition in order to direct their diagnostic consultations. Such learning goal suggests their intentions to use backward diagnostic reasoning strategies.

*“...So I was kind of screening for conditions, like risk factors which kind of linked to an MI” (p#8)*

*“ . . . I was suspecting COPD as well, so there is a likely smoking history, so there is probably that risk factor, I haven't asked that question yet, but it's getting there.” (p#9)*

*“...So kind of like again going to risk factors of like a social history, so I probably asked like drinking, smoking, housing and occupation ” (p#8)*

Students also frequently asked about risk factors that they considered relevant for certain conditions. They were using such information in order to determine the likelihood of their diagnostic hypothesis. They would interpret the presence of relevant

risk factors as supporting evidence for their diagnostic hypothesis. Risk factors are part of the ‘enabling conditions’ of an illness that expert tend to make use of during the diagnostic process. Using such information could be an indication of a step towards knowledge encapsulation and illness script formation, however, only if the information is not interpreted as a causal explanation whereby the presence or absence of the risk factor is taken as conclusive evidence for the presence or absence of the associated condition. It wasn’t clear from the students’ account how much causality they attributed to the presence of risk factors.

*“... so all this time I was sort of floundering, trying to get, then I got onto those key, closed, red-flag questions, all the key questions you are supposed to ask I memorized for my exams, but finally came to me at that point” (p#7)*

*“... I am worried about malignancy, so in my head I am thinking, what questions do I need to ask for cancer, so I am saying, so then I am working through a list yeah...And now I am working through a different list, I am working through a list again, but it’s a different list, so now I am working through a list of any kind of damage to the spinal cord, and kind of red flag from that point of view” (p#10)*

*“... Now I have got another list that I am thinking about, so now I am thinking about any kind of inflammatory, autoimmune disease...And that’s why I am asking about those. So then I am going to ask about like bowel and skin. So yeah, always through like a checklist I think” (p#10)*

Students also made use of red flag symptom checklists to assist their diagnostic reasoning. Red flag questions cover signs and symptoms that indicate the possibility of a serious underlying condition, and students used these to rule out serious conditions that could be associated with the presenting complaints. Students covered red flag questions both when it was indicated by the history as well as in cases when it wasn’t directly indicated by the history. They seemed to be motivated to make sure not to miss a serious diagnosis that could be associated with the presenting complaints. Some students were adopting an exhaustive, systematic approach, where they were working through numerous red-flag checklists one after another in order to cover as many red flag lists as possible.

*“...At this point I was pretty certain what I thought it was going to be, but I was still asking these questions, and I know like proper reasons, like blood in the urine possibly might mean [kidney-] stones, stuff like that, but it’s not very likely, but just asking questions. So I guess that is kind of a good thing, because I am still excluding things... I still try to think about what else it could be” (p#2)*

*“...So it’s kind of like **excluding differentials although I have kind of got a firm picture**” (p#8)*

Students often demonstrated keeping an open mind during the consultation by continuing to come up with more and more differentials as the consultation went on. They often continued testing various differentials even when they seemed to have a firm working diagnosis in mind. This approach is beneficial for avoiding premature closure during the diagnostic process. In fact, the exhaustive hypothesis testing approach of the students relies greatly on the differential list – the more differentials are generated based on the history the higher the chance of diagnostic success. Therefore, the students’ open-minded approach benefits their diagnostic strategy.

*Student: “**I already know that, what it is, but I am trying to find out whether it’s something else**”*

*Researcher: “So do you try to rule out things or rule in things?”*

*Student: “I think sometimes I feel like **because you constantly walk around feeling like not knowing it all, so whenever you recognize something or think you know what it is, it’s so surprising, so you go like ‘maybe it’s really not that’ just try to find out if it’s something else**” (p#5)*

However, one students’ account suggested that the reason behind keeping an open mind can sometimes be a lack of confidence in their own diagnostic skills. One participant explained that the doubt in her diagnostic skills means that even when she arrives at a diagnostic conclusion, she will continue to test further hypotheses in case she was wrong. However, the time limitations of primary care setting do not allow for infinite hypothesis testing. Students need to learn to come to terms with the inherent diagnostic uncertainty of the primary care setting and make use of safety netting strategies to be able to close the consultation.

### **DIFFICULTIES WITH RELYING ON MEMORIZED LISTS**

Relying on memorized lists indicated an effortful diagnostic process and it was associated with various challenges and pitfalls. These difficulties involved the inability to recall all the relevant questions of the lists, their lack of knowledge about the relevance and usefulness of the questions, and their inability to interpret the information collected through the lists of questions in relation with the working diagnosis in mind.

*“...The only other thing that I can think of is just **I would have asked more questions had I have a longer list in my head** with the pre-eclampsia, so I said light headedness, and then I think fever, hot and sweaty, which **I was slightly getting unsure of symptoms that are essential**, so that is the only thing I can think of.” (p#12)*

***“ . . . I was trying to do like infectious questions, but I couldn't really remember”***  
(p#1)

***“ . . . The topic was familiar like the other one, but I kind of wasn't sure what I need to be asking.”*** (p#2)

Students frequently mentioned an inability to recall the essential symptoms associated with various conditions. Without such essential knowledge, they couldn't use their hypothesis testing process effectively. At times such knowledge seemed inaccessible, while at other times it seemed lacking completely. Insufficient knowledge about the relevant symptoms made them less confident in the diagnostic process.

***“...I think my diagnostic skills are at a stage today where I know the questions, and I will ask those questions, and sometimes I am not quite sure why I am asking questions exactly. I know roughly why I am asking it, but I still ask it. And if you ask me why I was asking it I will be like because I learnt it in the lecture somewhere rather than because I am trying to get down to a certain thing.”***  
(p#2)

***“...This seemed kind of like, always seems to be drummed into us medical students when you asking about smoking... so I always feel the need to ask, but I never know if it's a waste of time or not”*** (p#8)

***“ . . . I didn't really know why I was asking that one, it was sort of for completion's sake... if you are in A&E, that sort of questions is really useful, but in this setting, I didn't know how much worth that was.”*** (p#7)

***“...I guess it's kind of like, well she doesn't have depression then why do I need to ask about the suicidal ideation? But it might be that she has anxiety and is suicidal, because again that's something that I should be asking, but I didn't pick up, because I thought well...probably not suicidal. But you see, it seems weird for me to then go 'have you ever thought about ending your life?' Do you know, it's a bit umm”*** (p#4)

Another difficulty associated with the use of memorized checklists was when students did not know the diagnostic relevance of the questions on that list. At times they memorized the list of questions, and successfully recalled them, but at the same time that did not understand why they were supposed to ask those questions, as they did not seem diagnostically relevant from their point of view. Knowing the list of questions, but not knowing the diagnostic value of them can give the illusion of diagnostic competence for observers while disguising the lack of actual reasoning.

***“...I asked blood, and then I was like ooh I don't remember, could there be blood in an infectious thing?”*** (p#1)

***“...At this point I was like argh, I have no idea what that means, I didn't know whether he had it, some similar thing or is it just for little kids [...] so I didn't***

*know what to do with that piece of information, so I just kept asking anything else I could [...]" (p#1)*

*"...So I knew that **when I am taking history**, that there should be things that **I was asking, and they would give an answer**, and I kind of would be aware enough that it would be something, that would be a flag, but **I didn't know enough of it to actually link it down to**, so I think in fourth year it's kind of like you are trying to bring everything together, but you **don't quite have the knowledge to do it...at the moment** I am feeling like I almost have it, but kind of **stabbing in the dark**." (p#1)*

Finally, another difficulty was when students did not know how to interpret the answer to the memorized lists of questions. One participant explained that even though she did not know how to use information she was gathering, she just kept on asking the questions. She was ignoring the information and proceeded with further questions. In these cases, asking the list of relevant questions can appear to the observer as a sign of competence, while disguising the student's lack of knowledge on how to interpret the answers to those questions. Without such knowledge however, diagnostic reasoning is greatly restricted, as it prevents the student from progressing further in the diagnostic process. According to one of the students, at this stage of their training they often do not possess sufficient amount of medical knowledge to know how to interpret the information they are gathering during the consultations.

#### **5.3.2.4 Using examinations and test results**

Besides relying on the information gathered through history taking, some of the simulated stations also allowed students access to relevant physical examinations results in order to aid their diagnostic process. These varied from basic observations, through dip stick results, to ECG results.

*"...In some ways, yeah, but also partly I think um I was thinking more and more cancer just because of the weight loss, and I still don't know any massive amounts of history **that could differentiate between varicose vein or epidemical cyst**, I feel like that is more **an examination finding**, I may be wrong about that, but yes, so I thought the next step that would tell me the most information would be the examination" (p#12)*

*"...**Up to that point**, trying to ask as many questions as I can as I think are relevant to testicular lump, including for example family history, which he gave a slightly vague or answer that he didn't really know essentially, which just is may or may not be related, not quite sure, um so **having run out of questions**, or for the **it's time essentially to start examination**, and then if there is anything more that I can think of then I can come back to it." (p#12)*

As one participant described, physical examination can be very useful when the history did not reveal sufficient information to be able to discriminate between various differentials in mind. Using physical examination in these cases can help resolve the ambiguities and clarify the diagnosis. Some participants demonstrated a confident approach in performing physical examinations, while other seemed less certain, especially when it came to intimate examinations.

*“...So after examination, I have felt the lump on the left side, I have also felt one on the right, although we found out later that that’s not intentional. So **it was hard, it was localized, and it felt most likely to me to be cancer** or the very least was definitely reaching the threshold for a two-week referral, so **by the time I had done the examination I decided** that that was what I was going to try to say and explain to him unless there was any new information that would present itself, and it would be cancer until proven otherwise essentially.” (p#12)*

*“...the bottle has all the information there for you, it’s just, it’s okay to compare, so I was trying to talk it out loud so that the patient was aware of what I was doing, so **nitrates and leukocytes have been raised, essentially that’s the diagnosis for UTI in my mind**, and then just mention the protein so, in relation to the blood pressure, protein, as far as pre-eclampsia is concerned, not only I have got the list, but I am also **trying to think yes okay there is a raised blood pressure, there is some protein, is that enough to make me worry about pre-eclampsia**, so that’s the second question coming in there. And in this case I didn’t think it was enough to be worried about.” (p#12)*

*“...I also wasn’t confident enough to be like there is nothing wrong with this ECG” (p#6)*

*“...From the ECG I wasn’t like too comfortable reading it” (p#8)*

At times they seemed confident in interpreting how the physical examination and test results could influence the likelihood of their differentials. In these cases, the examination results were perceived as vital in reaching a diagnosis and selecting the appropriate management plan. In other cases, students were struggling with interpreting examinations and test results. They did not know what the findings meant with regards to the differentials in mind. There was not only heterogeneity between students with regards to their diagnostic interpretation skills, but also case dependent competency within individuals.

*“...Yeah, so this one was UTI, so it is a bit more like, I had this consultation at the GP practice, so I felt **more at ease**, because **when have to look at the urine test, you will kind of knew what the end diagnosis is going to be**. I felt a lot more like, when I was doing my questions, **I could be a lot more focused, because I knew what I was going for kind of**” (p#1)*

*“...So I knew, I didn't know that leukocytes and proteins would be indications for UTI, and then I was looking at the pH and I was like not really sure what that means, so if it would be more complicated ...but to be honest at this point I was just like barrelling down to the UTI, I have decided that it was UTI.” (p#1)*

Another problem that arose when using test results in the diagnostic process was when the student already decided about the diagnosis, before looking at the test results. In the extracts above, the student interpreted the test results in a way to fit the diagnosis, instead of testing the accuracy of the diagnosis against the results. Such confirmation bias can be a source of diagnostic error. It also gives the illusion of diagnostic reasoning for the observers, while disguising the cognitive bias. Finally, none of the students mentioned any awareness to the significance of pre-test probabilities in a primary care setting for the interpretation of test results.

#### **5.3.2.5 Metacognitive interference**

Students demonstrated the use of metacognition during the consultations. They were often monitoring, analysing and planning their behaviours. However, such metacognitive practice often interfered with their listening skills as they found it difficult to balance thinking, talking and listen to the patient.

*“...I am really floundering here...I am trying to think and talk and it's just so hard” (p#7)*

*“...So we are in unfamiliar territory here, I haven't sort of managed this particular situation before, so I am sort of I don't know the guidelines, I am trying to think through while sort of not stopping, so it's all a bit hazy from here on a bit” (p#6)*

Students expressed difficulties with trying to think and talk at the same time. As students perceived pressure to keep talking, they did not allow themselves space for silence during the consultations. This meant that they were trying to think through their diagnostic ideas while at the same time keeping up the conversation with the patient, which they found challenging.

*Student: “But I see myself and I can see that I am blinking a lot, saying okay without waiting for the patient to completely finish their sentence, because I am thinking in my head, what should I ask now?”*

*Researcher: “So you are already on the next question?”*

*Student: “Yes, and not just relaxing and giving time to hear what I am saying, what they are saying to me.” (p#5)*

*“...I think at this point, I was thinking of the next questions, so I don’t actually remember the answer he gave to that question. So later in the consultation I think I was like something else was wrong, but I can’t quite remember what he said, because I was thinking of the next question.” (p#6)*

*“...So you could see, where he was leading, and I was sort of trying to run it through in my head what I was going to say. So I wasn’t, the problem is that sometimes I realize that I don’t listen to what they are saying while I am trying to do that, so I am not sure if I am actually listening to him all that well” (p#7)*

One frequently mentioned process involved thinking about the next thing to ask the patient interfering with listening to the patient’s answer to the previous question. When thinking about what to ask next prevented students from listening to the patient’s answers to previous questions, it meant that students could not use that piece of information in the diagnostic process.

*“...Again, kind of in that sort of situation, I had already kind of like thought of my next question, so I was kind of just ready to move on, because I didn’t really think he would benefit it” (p#8)*

*“...I think at this point I wasn’t really listening to what he was saying very much, because I knew, he was just building up a picture of someone who has cardiovascular disease, and I kind of knew what every section there would be some kind of a risk factor coming up, so when he started ...off the medications, I was like okay, fine you are on heart medication, shall we get to the next point?” (p#6)*

It seemed that students attached more importance to keep asking questions than to using the information they are gathering for the diagnostic process. Also, at times students mentioned that they thought they already knew what the patient was going to say and therefore did not feel the need to listen to the answer, which suggests that standardized scenarios can become predictable with time and no longer encourage active listening.

*“...I felt like I, with the maybe, I was a bit not assertive or be as confident as I was with my questioning. As soon as I said it I was like okay, as soon as I said it I thought like I could have just said it just without the maybe, it would have sounded much more confident at what I was asking her, but by trying to be a bit more, you know by saying maybe, and raising my voice a bit, with my intonation it sort of made it less, seem like I am less sure of what I am trying to ask of her. Which I realised when I was doing it actually, and also thinking about those things meant that I didn’t sometimes listen to the nuances of what was going on.” (p#7)*

*“...Oh wait, I am, I was just doing it behind my back, I was following his signing, so he was signing to his back and I was doing the same, which I haven’t, which I think I realized I was doing actually at the time. But I tried to stop myself, but I couldn’t, but I am trying to talk and not do something, I was doing it anyway, because I saw him signing and I was like I shouldn’t sign, but*

*then he said oh my lower back pain and pointed to the back so I pointed at my back and said oh so the lower back pain.” (p#7)*

Students’ metacognition also revolved around their own non-verbal communication and how they might come across to the patient. Thinking about what they were doing in the moment and how they could do it better meant that they got distracted and failed to listen to the patient. Thinking about how they come across also implies self-consciousness and focusing their attention on the self instead of the patient. This may have been advantageous to identify their personal learning goals, but served as a momentary distraction as well.

*Student: “I thought I sounded a bit too, almost too concerned, and I was signing a lot I realized, I am signing an awful lot.”*

*Researcher: “Did you realize it back then?”*

*Student: “Yeah, well when I was doing it I realized it but I, watching it back it’s even more obvious, but then I don’t know what to do with my hands, I try to hold them in one consultation, I think the next one, that may seem like I wasn’t, I was a bit shut down, it’s quite hard balancing it.”*

*Researcher: “Yeah it’s difficult”*

*Student: “Yeah, also I think I was, I think my, how I’m talking is quite, you know it’s good, but if the patient was depressed or something I’s probably a good way of doing it because I speak quite softly, but I don’t know if it’s so relevant in her case. I think I was, I am still trying to figure out what’s going on.” (p#7)*

Students spent time analysing their tone of voice and body language and its appropriateness in certain scenarios. The student also implies that they are at a stage where they are actively working on their non-verbal communication, finding it quite difficult to perfect it.

*“...I guess it is one of the skills that develop once you stop being a student, once you are a doctor, but as a student still, you know, I think I should try to develop that ability to try to listen and formulate at the same time. I think I am formulating while I am listening.” (p#7)*

When talking about their present and future skills, students expected to develop improved metacognitive skills by the time they are qualified doctors. They expect to be better able to utilise metacognition in a way that does not interfere with their listening skills.

#### **5.3.2.6 Diagnosis and management**

#### **TAKING ON THE DECISION MAKING ROLE**

The Simulated Surgeries provide the first opportunity for these fourth-year medical students to take on the role of managing patients' problems. Up to that point, their medical training has been mainly focused on taking histories without having to make decisions about the diagnosis and the corresponding management.

*"...I think it's, I think for me personally, it's a bit challenging for me to kind of comfortably and confidently come with a management plan, because I am still at the mode of like you know make sure **you know your history and can take history properly and then the management is someone else is going to do that.**" (p#5)*

*"...we **practice histories** and I feel quite okay talking to somebody, and asking questions and talking about it and discussing it, **but coming to a decision is difficult**" (p#11)*

*"...But yeah, I think it is **quite challenging to know that you are actually reached the right diagnosis**, like you are not wrong, and you are giving the right advice. **Because I haven't really thought about management until now**" (p#3)*

*"...I think it is **the first time we have sort of been push to initiate management as well, which we don't really do in the first three years**, so yeah, it is really valuable." (p#9)*

Students expressed feeling confident about their history taking skills. On the other hand, they find it challenging to come to decisions about diagnosis and management at this stage. Their account suggests that up until now, when they were given the task of taking history, they have not engaged in thinking about the management of the patients' problem. They have been focusing on the history in isolation. During their clinical placements they have not yet given the opportunity for autonomous decision making during the diagnostic process, therefore these Simulated Surgeries are their first chance to experience the responsibility of taking on the decision-making role in diagnosis and management.

*"...I think then **the hardest bit is deciding what to do, what is the best thing to do, yeah.**" (p#11)*

*"...So just to, because I think, and it's **not because I necessarily don't know what to do**, it's more like **because I feel like I am making the decision**, if you understand, and that's **a bit scary**... And so I guess, even if I knew what I was going to do, and said it more comfortably, and I think that's the main thing about what you need to kind of get up to that level where you can comfortably sit and say to a patient you are going to, we are going to do this, and that, and this and this, and your plan, and you know like this is what I think you should do." (p#5)*

*“... it’s having the confidence to say this is what J am going to do to this person, and J am confident that that’s going to help them rather than sort of do nothing or worse, be dangerous, so yeah, that’s the most challenging bit J would say, yeah.” (p#9)*

Students expressed that they find it difficult to take on the responsibility of decision making during the consultations. They often seemed lacking confidence in their ability to come to the right diagnosis and choose the best management plan for the patient. Given that this is the first time they are given such responsibility, their uncertainty in their own skills is not surprising. This also indicates that providing them opportunities where they can be in charge of decision making are in line with their learning needs.

*“...Umm I suppose, so when you are kind of taking history or talking to a patient, having a structured approach in your mind, not just umm kind of doing things for nothing, but **trying to narrow it down to a differential** and being able to hear **the information you get and thinking back, apply it to that differential, can I use it, and rule out something else, rather than just getting all this information and not having narrowed it down.** So a bit like a pyramid or triangle, going down the triangle (gesturing an inverted triangle). You really want to end up with one or two things it could be” (p#1)*

When reflecting about their present and future competencies, some expressed that they expect their diagnostic reasoning skills to improve with time. Their account suggests that narrowing down differentials is a current weakness, and that they find it difficult to apply information they collect to their working diagnosis. With time and experience, they expect to be better able to narrow down their list of differentials, instead of merely accumulating information that they tend to do at the moment.

### **LIMITED EXPERIENCE AND KNOWLEDGE**

Having limited clinical experience and gaps in their knowledge relating to management guidelines were among the most frequently mentioned difficulties relating to management.

*“...I was at GP last week and there were a couple of patients that I have seen with UTI so quite happy with the symptoms, but **I have not prescribed antibiotics ever**, you know I might have done it in a simulated fashion, and so if **I have done that even just for five patients, I would be happy that yeah okay this fits with my experience of those five other patients then I would be a lot more confident in myself, that would be the most challenging thing I think.**” (p#12)*

*“...So it was the lower back pain thing, and I guess **because I just finished my muscular-skeletal rotation, so I feel reasonably confident on management of lower back pain**” (p#7)*

*“...I have seen it a fair few times, so it would be one of my more confident things I think today in comparison to the others perhaps yeah.” (p#12)*

Those students who have done a relevant clinical placement felt more competent at managing those conditions they had previous experience with. Students expressed that having the opportunity to manage certain conditions even just a few times in real practice would make them more comfortable, showing the perceived importance of clinical experience for their management skills.

*“...Yeah, so I was like kind of like **thrown off, because I was in a GP surgery, like thinking like what would a GP do, because all the way through the three years of medical school you are just, you always get told to like call for senior of you, or page your senior of you like you never think of yourself like inside a GP surgery, and it’s kind of like in the mind-set I am in A&E, or like in an acute presentation... you never think like oh you are not in a hospital, so that was kind of I was confused by that” (p#8)***

*“...Yeah, the problem that I have had with all of this is that I, we always kind of get told if people think it is exacerbation of COPD you do tend to give them antibiotics, but the problem is **in our lectures we have been told like you should delay prescribe, you should try not prescribe, you should give alternative strategies,... so I wasn’t sure which protocol to follow, cause I have only really attended hospital medicine and this is kind of like different, so in my mind I was like oh is this the station where you need to like educate them on the problems of antibiotics and you don’t need to give them, so that’s kind of like what, I think I was pre-primed to not wanting to give them” (p#8)***

Another difficulty that students mentioned with regards to management was that the scenarios were set in a primary care setting. Since most of their previous clinical placements took place in a secondary care setting, sometimes they were not sure whether the same management plan would apply here. They feel the primary care setting requires a different approach and management protocols that they are less familiar with.

*“...Yeah I wasn’t sure what to say because his ECG is fine, we know he is not having an acute myocardial infarction and acute coronary syndrome, but **I wasn’t really sure of the management” (p#3)***

*“...So we are in **unfamiliar territory here, I haven’t sort of managed this particular situation before, so I am sort of I don’t know the guidelines” (p#9)***

*“...I thought that there was only one option in a way, I just had to tell him, there is no way I could have answered for him if it was a real patient what that lump was without further tests, and I was fairly sure that given the examination findings, given the weight loss, that he needed to be seen by a specialist, so **I was quite confident to do that and confident that that was the right thing to do for his care.” (p#12)***

Some students attributed their difficulties with managing patients to their insufficient knowledge regarding the management guidelines. Such knowledge is a necessary prerequisite for being able to decide on the appropriate management plan. Knowledge of management guidelines seemed both dependent on the individual student and on the specific case in hand. Certain students demonstrated more domain knowledge than others, which highlighted individual variations with regards to content knowledge within the same year group. Students' knowledge also varied from case to case leading to content dependency in management skills.

*“...I mean, for me personally, as it was today, it’s just like, lacks some actual kind of medical knowledge, of what did I miss, and what the actual management was. So I knew that when I am taking history, that there should be things that I was asking, and they would give an answer, and I kind of would be aware enough that it would be something, that would be a flag, but I didn’t know enough of it to actually link it down to, so I think **in fourth year it’s kind of like you are trying to bring everything together, but you don’t quite have the knowledge to do it, but while, hopefully, by the time you are a junior you would actually have the knowledge and then you can,** and when things will come together and then you will be like yes, I know why that. But at the moment I am feeling like I almost have it, but kind of stabbing in the dark.” (p#1)*

When talking about their current diagnostic skills students also described the knowledge they were expecting to obtain by the time they are junior doctors. Students expected to have more medical knowledge by the time they are qualified doctors. They are expecting that increased knowledge to help them formulate a better understanding of the patients' problems.

### **5.3.3 Challenges in consultation skills**

Simulated Surgeries provide an opportunity for students to practice their communication and interpersonal skills with standardized patients. While students seemed very competent at showing empathy and building rapport with the patients, there were other domains of their consultation skills that they experienced some difficulties with. The third superordinate theme described the challenges students faced with respect to consultation and communication skills. It is shown how some students found it challenging to bring up sensitive issues, while others found it difficult to find the words to reassure patients. Some students also struggled with translating medical jargon into lay terms in order to achieve mutual understanding with the patients. Finally, while no-verbal communication cues at times helped students to guide the consultation, at other times those cues were misread by some students. These aspects of students'

consultation skills were greatly interconnected with their diagnostic process and they can restrict students' diagnostic abilities.

### **5.3.3.1 Interpersonal skills**

Bringing up and discussing sensitive issues during the consultations was one of the perceived challenges of the simulation. Some students found it difficult to talk about sensitive topics, such as questions relating to depression and suicide, symptoms that would indicate serious illness, or diagnoses that could make the patient feel uncomfortable.

*“...Yeah, so they were related, because you know I was trying to see if the person was depressed, and that depression was playing a part, I had those sort of key questions, and I also at this point **I always want to ask about suicidal ideation**, something you are supposed to ask in any sort of mental health quiz, I think after mood **I really wanted to ask it, but in her case it just seemed like that the question would have come out of nowhere, I didn't want to do that, and then I saw the mark sheet that they did have that down, so I had a real moment here**” (p#7)*

*“...the likelihood that he has a GI bleed is very small, but it's a massive risk associated with Naproxen so **how do you stay safe and make sure he hasn't had that side effect whilst not being a bit weird and random and asking him about, do you see what I mean.**” (p#4)*

*“...I still got to learn how to do that, like that whole **ruling out things that are dangerous, without making them feel uncomfortable**” (p#4)*

They found that at times bringing up sensitive issues would be too abrupt, and therefore avoided asking them, even when it could have revealed diagnostic information about the patient. They seemed to have an aversion to evoking uncomfortable feelings in the patient during the consultations, such as fear, shock, or anxiety. However, not being able to bring up and address sensitive issues and symptoms can result in missing serious diagnosis.

*“...it's become less difficult with time, things like asking about alcohol, smoking and things like that” (p#4)*

*“...I just find it quite difficult, because I know when they say that when you ask about depressive symptoms, when you ask about suicide, it doesn't make it more likely that they are going to do that, but I just find, if you've already got rapport with the patient and they are talking about their anxiety, **bringing up depression and suicide can be quite, can be very difficult considering I have only got seven minutes**” (p#4)*

One student pointed out that experience and practice could help improve the students' skills in addressing sensitive issues during the consultations. Repeated exposure could desensitize students for the aversion of evoking anxiety in patients. Some students also thought that having longer time for the consultation could help bring up sensitive issues. They considered the seven minute time limit too short to address sensitive issues such as suicide. This highlights the importance of flexibility in the length of consultations, as for some consultations where the students need to address sensitive issues, they may need longer time to complete.

*"... when they think they have something more serious than you see they do, kind of telling them and **reassuring them**, and **just calming them and then just say oh no I don't think you have that**, but I think this is, and **that's a bit difficult for me still.**" (p#5)*

*"...I wanted to reassure him, but I didn't know how to go about doing that 'from your point of view it's quite concerning' but that doesn't really say anything. I always find that quite tough, because you don't want to, you don't want to give, of course it's concerning, but **you don't want to almost give into what's oh yeah yeah yeah, this is really concerning, you're concerned, so I'm concerned sort of thing**" (p#7)*

*"...it's like what word, because you don't want to use the word **malignant**, because that immediately to everybody makes them think horrible things. What word do you use which encompasses the fact that I understand that it is serious cause it is affecting your life, so I don't want to say oh you have got a minor problem, he hasn't got a minor problem, he has got a major problem, **but it's not major like cancer.**" (p#4)*

Some students said that they find it challenging to find the right words to reassure patients without dismissing their worries. They find it difficult to express their understanding while reassuring and not sharing the concern of the patient. The students' use of words, "you don't want to almost give into", suggests perceived pressure from the patient to share their concern, which students can find difficult to handle.

*"...It's quite difficult, as you can see **I am trying to be like empathetic with her, but then I have to go back to clinical questions. I find it really difficult to do that.** Like you can see there I have gone from like normal person mode to being empathetic to then having to, not that a doctor isn't a normal person, but you know you also have to like ask clinical questions, so it's, you can see that I have done my, I tried to be empathetic, and then I had to go back to ask her about other associated symptoms. So I find that quite difficult, and I think **that's probably from inexperience, and again hopefully that will get better over time.**" (P#4)*

Finally, when thinking about their future competencies, students expect to have improved consultation skills. They expect to be better able to balance showing empathy

towards the patient and asking them standard, systematic questions. All in all, students expressed to have more knowledge, better diagnostic skills, better consultation skills and better use of metacognition by the time they qualify.

### 5.3.3.2 *Communication skills*

At times students had difficulties with translating medical jargon into lay terms that the patient would understand. Preoccupation with these issues added to the cognitive load of the consultations. Students were also influenced by the non-verbal cues of the patient which at times was source for misunderstanding.

*“...You see there I was like trying to think of a word that wasn't, because it can affect all of your bowels, GI track, **just trying to think of a word that the patient understands**, but I didn't want to say tummy, and that was the first one that came to my mind, and I was like tummy that's a lay men's word for a GI tract, but tummy is like what you say to a five-year-old.” (p#4)*

*“...Yeah, **I didn't know how to phrase that question**, how would you say your self, how would you say your self-esteem is? I wanted to get that down, but I didn't want to say the words, then **I don't know how to phrase it, so I had a bit of trouble there**” (p#7)*

*“...Again **you can see that I am nervous**, and if I am nervous, that makes him nervous, so it should just be like, because the thing about is that sensation is associated with certain back pain is very specific to the perianal area, so it's not just like sensational loss of the bum itself, it's actually like closer up towards the perianal area, and then the thing in a man that you can ask is basically 'have you noticed any sensational difference when you wipe your bottom after you poo?' Basically, but **how do you say that? How do you say that that's not childish** as in using the word poop, but like **adult enough that he understands?**” (p#4)*

Some students had frequent difficulties with trying to find the right words or expressions to use when trying to explain something to the patient. At times they found it difficult to translate medical terms into ones that the patient could understand but without being too simplistic. These communicational weaknesses indicate a need for more clinical practice in order for students to improve their verbal communication with patients.

*“...**I always have trouble asking about ideas, concerns, and expectations, I just never know how to phrase it, I have tried a lot of different phrases, but none of them really worked for me**” (p#7)*

*“...**I never know if to phrase it** as 'how much alcohol do you drink at the moment' or 'how much alcohol do you drink in a typical week' or 'how often do you regularly exceed 8 drinks in a week'...” (p#8)*

*“...She probably doesn't even know what a nervous system is. Looking back I think when I was saying that, how I meant to say this, and I get better at it in a minute, but nervous system, looking at it, she might not know what that is, so I should probably think of a different word there.” (p#4)*

At times, students even struggled to find the best way to phrase standard history questions. Their account suggests that they are at a stage where they are trying out different ways to ask these questions in the hopes of finding the most suitable one. This highlights the importance of the opportunities for students to practice their communication skills.

*“...I always have a lot of trouble right at the beginning, if I should, date of birth is what you use to confirm and someone's name, but in this sort of situation when you are talking to them, age is so much more useful, because I really don't want to work out the date of birth, and in this case, I didn't know, I just from the beginning I had no idea what his age was.” (p#7)*

*“... in my head I was like, no, not tummy, umm and I probably just should have said 'have you had any problems with your stomach', because sometimes people think their stomach takes up the whole of the [abdomen], if you see what I mean, like it can feel like pain from the stomach.” (p#4)*

The students were consciously thinking about their verbal communication, the words and expressions they were using, which indicates the use of metacognition in this domain. As they were monitoring their own verbal communication, at times they recognized mistakes that they have made, such as conveying the wrong message to the patient, and opportunities for improvement with regards to their communication.

*“...I think I asked that question because he looked like he hasn't finished yet, he was there like, and I was like 'so do you want to say anything else?', and he was like 'Yes'” (p#6)*

Students at times were consciously using the body language of the patient as an additional information source.

Here the body language of the patient was a cue that provoked further questions from the student. Such information is not available during written diagnostic problems, giving a higher fidelity and validity to simulated exercise.

*Student: “You can see that I am blinking a lot, I am nervous, because I really don't know where I am going and I forgot my, I don't have my like my train of thoughts, I have completely lost it, because I, the way he looked at me when I said I don't want to expose you to too much radiation, he looked at me, and”  
Researcher: “The patient?”*

*Student: “The patient, and **then I felt like shall I ignore this?** Or shall I just make sure that he understands or does he maybe have questions and then I just felt like I went a little bit left field with the whole thing. I know it’s interesting to hear like, his feedback, when he was like, oh maybe you shouldn’t have explained that to me, then **I felt like oh I read your signals wrong then.**” (p#5)*

*Student: “And these are the only scenarios we get to practice real with someone you don’t know, and don’t feel comfortable with, because **it is nothing like when you practicing at home with your friends**, so different, we know each other, we know each other. Another thing, just like I am saying here, **I felt like I read him wrong.**”*

*Researcher: “**Which wouldn’t happen with your friend**”*

*Student: “**No, because you know their little, you know kind of their body language**, and it gives you a clue, whether you are on the right track or not” (p#5)*

At times students misinterpreted the body language of the patients. One student pointed out the importance of the opportunity to practice consultations with people they do not know. When they practice with their peers, their body language can give them away, while actors are non-familiar to the students. The students’ account suggests that the interpretation of the non-verbal communication of the patient forms an important part of the consultation, which highlight the significance of the human element in both practice and assessment scenarios.

## 5.4 PHASE 2 – IPA FINDINGS

Similarly to phase 1, each reflective interview was transcribed by the researcher then the transcripts were analysed using IPA process of Smith, Flowers, and Larkin (2009), as described previously. The analysis of the transcripts based on the experiences of final year medical students' real diagnostic primary care consultations revealed four superordinate themes, and ten corresponding subthemes (See *Table 7*). The superordinate themes were (1) diagnostic reasoning, (2) and training and preparedness for practice.

The first superordinate theme involved the diagnostic strategies when dealing with common and complex diagnostic cases, dealing with uncertainty, management in primary care, the student's perception of salient features of the diagnostic process in primary care. The second theme involved the students' reflections about the differences between consultation patterns they observe during their training as opposed to those observed in real practice. They also reflect on their preparedness of practice and their perception of primary care placements as a training ground.

*Table 7: Themes based on the Year 5 interviews*

### **Superordinate theme I – DIAGNOSTIC REASONING**

- Theme I – 1. Generating differentials and hypothesis testing
- Theme I – 2. Non-linear hypothesis testing
- Theme I – 3. Using physical examinations to guide diagnosis
- Theme I – 4. Atypical symptom presentation and co-morbidity
- Theme I – 5. Dealing with uncertainty
- Theme I – 6. Content dependent management skills
- Theme I – 7. Patient-doctor dynamics

### **Superordinate theme II – TRAINING AND PREPAREDNESS FOR PRACTICE**

- Theme II – 1. Medical school protocol versus real practice
- Theme II – 2. Preparedness for practice
- Theme II – 3. Primary care as training ground

### 5.4.1 Diagnostic reasoning

The participants' diagnostic reasoning was characterized predominantly by backward reasoning strategies. They had a tendency to generate multiple differentials as listening to the presenting complaints and collecting information accordingly to choose the most likely differentials. However, when faced with a difficult case, narrowing down differentials was challenging and resulted in non-linear hypothesis testing and moving back and forth between the differentials. They showed emerging awareness of atypical symptom presentation and the possibility of multiple problems. They used basic examination skills to guide their diagnosis, although found some clinical skills challenging. Their main strategy to deal with uncertainty was to turn to their supervisors and using the continuity of care model of primary care for safety netting. They seemed confident in managing routine problems in primary care, and showed awareness of the psychological side of consultations.

#### 5.4.1.1 Generating differentials and hypothesis testing

The first thing influencing the diagnostic reasoning of final year medical students was reading the patient notes which contained the presenting complaint of the patient and their past medical history. Before even seeing the patients, the students formed working diagnoses based on the information in the patient notes.

*“...I actually read through her past medical history, and I saw she has got depression...in the past, and also an eating disorder, so I knew that this could be a relapse of a condition.” (p#14)*

In the above example, reading the past medical history of the patient influenced the formation of the working diagnosis. However, the use or awareness of any cognitive debiasing strategies to deal with these preconceived ideas based on the presenting complaint was not mentioned. There is also a risk of overestimating the likelihood of a diagnosis based on the patient's previous diagnoses, also referred to as posterior probability bias, which the student did not seem to be aware of.

*“...And when she has told me that she has been having low mood and everything, I think she is having a relapse. So, and I don't know, at that point, the consultation is going towards talking about her depression, if there are any changes in sort of what's going on in her life, and so she said, she has started a new job, and that it's stressful, and also the mental breakdown, so yeah, at this point, I am quite yeah, I knew what's going on.” (p#14)*

*Student: “At the beginning, I knew that it was going in that direction, but towards the end I was quite sure, because of the symptoms that she was having,*

*low mood, low energy, the break down, the suicidal ideation, she is feeling a bit hopeless, so I kind of knew the symptoms.”*

*Researcher: “Are you thinking it might be anything else at this point, or?”*

*Student: “At this point, no, but initially, **I was also thinking about anxiety disorder**, but she didn’t really have much, yeah.”*

*Researcher: “What makes you think she didn’t?”*

*Student: “Umm, the fact that you know **if you are anxious, you have other symptoms**, like you know your heart is racing really fast, you feel tingling, things like that, you don’t want to go out much, but she works, people who are anxious they wouldn’t want to do their jobs and things like that.” (p#14)*

Listening to the presenting complaint of the patients made the student formulate a working diagnosis and consider an alternative differential that may also explain the signs and symptoms. In the abstract above, considering the associated symptoms helped the student contrast the two differentials in mind and decide in favour of the one which fits the symptoms better. She has reached her diagnosis early on in the consultations and continued by exploring the course and potential causes of the patient’s problems.

*“...So, at that point **I was thinking, oh God, he has come in with a long-haul flight, could he be having a pulmonary embolism?** And that’s why I am asking, I thought okay, I need to go into shortness of breath and start **thinking about that route as well as the infectious route.**” (p#13)*

*“...**Looking for travelling infections**, thinking about things like neurocysticercosis that take over the brain. **Just all sorts of things** that come with dizziness, hearing problems, visual problems, just trying to really rule out...the likelihood of it being one of those weird travelling disorders or uncommon things.” (p#13)*

In a different consultation, while listening to the patient’s history, the participant considered both the most serious and the most common causes that would fit the clinical picture. The student acknowledged the travelling element of the patient’s history as a possible enabling factor, considering relevant differentials. The student tried to rule out rare conditions that could be associated with the country the patient has been visiting. The fact that the student considered common, serious and rare differentials alike shows an open-minded approach to the diagnostic process. However, it was also apparent that during the consultation the student was considering new differentials with every piece of emerging new information, instead of piecing the information together in a forward-thinking approach.

*“...my training in terms of general surgery is not great, and when I think about a bilious vomit, I really do only think of, there are lots of causes for obstruction, but I think of a **small intestinal obstruction**” (p#13)*

However, similarly to fourth-year students, generating more than one differential based on the symptoms was not always easy for the participants. Relating to certain areas, they did not have sufficient knowledge to generate multiple differentials, which can be an obstacle for the diagnostic process. The participant recognized this as a weakness in their medical training. This also suggests and explains content dependent diagnostic skills at their level of training.

*“...I don't like the phase to rule out, because **you can never really rule out**” (p#13)*

*“...It doesn't mean that he doesn't have it, it moves it down in my list in terms of suspicion” (p#13)*

When considering differentials, one participant suggested that ruling out differentials is never possible, and it should be rather understood as the differential becoming less likely. However, not being able to rule out differentials can be problematic as the list of differentials needs to be reduced in order to eventually reach a diagnosis and management plan. His account also suggests that he has a list of differentials in mind, ranked by likelihood, and that various pieces of information alter the likelihood of the differentials in his mind. This implies that he is actively processing the information collected from the patient and using it to guide his diagnostic reasoning which is characteristic of a probabilistic reasoning.

*“...That's just me trying to **make sure that he didn't have some underlying like COPD** or just something lung based involved, because **smoking** is just generally it's not very good, it can make you, certainly in terms of **it can make you much more susceptible to getting infections**” (p#13)*

*“...I was thinking **mosquitoes bite** people on bikes, because they are not going to be very well dressed, because it is very hot and they are doing a lot of exercise through a hot country.” (p#13)*

*“...Those are **symptoms of heart failure**, I just want to know” (p#14)*

The diagnostic process also involved assessing the presence of risk factors and red flag symptoms. The participants used this information to assess the likelihood of underlying chronic conditions, to support the working diagnosis or to rule out serious conditions. However, the list of risk factors and red flags did not tend to be exhaustive in any of the consultations, suggesting that the participants either did not consider them all relevant or failed to recall them all.

*Researcher: “How do you feel talking about issues, like sensitive issues, like taking her own life?”*

*Student: “Honestly speaking I don’t really like talking about this, but obviously you have to address it, because sometimes things can go wrong, so usually what I do is, I ask them more about what do you mean, how long have you been having these thoughts, and what is actually preventing them having to take their own life, so then she would say husband, kids doing their GCSEs, things like that.” (p#14)*

When red flag questions involve sensitive issues, the student tried to find a way to address those in a way that makes it less uncomfortable for herself. This suggests the development of adaptive coping strategies when dealing with sensitive questions.

*“...given his clinical picture, and the fact, you know, he did seem quite unwell, but he seemed unwell with more systemic infection” (p#13)*

At times participants also incorporated the clinical presentation of the patient into their diagnostic process. The comments above show the student basing his clinical judgement on the patient’s appearance when faced with a diagnostic dilemma. While this approach is often used correctly by experienced clinicians, it can also be a source of error when used by beginners, as it carries the risk of representativeness bias.

#### **5.4.1.2 Non-linear hypothesis testing**

When dealing with a complicated case, hypothesis testing approach was observed. However, this approach was not as linear as prescribed by the hypothetico-deductive approach. It was characterized by partially ruling out differentials as well as moving back and forth between differentials. On the positive side, contradictory information was not ignored, but incorporated into the diagnostic reasoning process.

*“...So that was me again moving back to pulmonary embolism” (p#13)*

*“...Leading me back towards the infectious cause or at least an inflammatory cause or something” (p#13)*

*“...Moving back towards PE, just to really, what’s the phase I am looking for, to re-convince myself that it is not a PE or anything like that” (p#13)*

When trying to solve a more complicated case, the participant did not proceed in a linear fashion and rule out differentials one by one, instead, he was going back and forth between various differentials. He found it challenging to rule out any of the differentials and he was also coming up with more and more differentials as the history was unfolding.

*“...so in his case, he has been on a long-haul flight, tick, **I didn’t really ask it, but you could ask about hypercoagulable disorders, blood disorders [...] family history of blood clots, could have gone into whether he had a red, hot, swollen leg, anything like that, and each of these things adds another tick in terms of clinical suspicion, and we then use something called the Wells score if you want to formally then go on and decide whether or not we think it is likely to be a PE.**” (p#13)*

Although he was aware of the relevant clinical decision rule that should be applied in this scenario, he failed to consider all the different elements of the decision rule, and only asked one question from the list. That may explain why he wasn’t able to confidently rule out the associated condition.

*“...that suddenly made the flowchart going down in my head completely re-route” (p#13)*

He describes his diagnostic process as resembling a flow-chart, which implies that he continuously incorporates information into his diagnostic process. Towards the end of the consultation, as the patient rephrased a particular piece of information, the student reinterpreted the whole case in light of that information and changed his diagnostic conclusions. This showed that conflicting information made him change his hypothesis instead of ignoring incongruent information and sticking with the original hypothesis, which was observed in the case of penultimate students.

#### **5.4.1.3 Using physical examinations to guide diagnosis**

During most consultations, students used basic physical examinations to aid their diagnostic process.

*“... So because she was in pain at night, **there is a few things that you need to look for in terms of leg injuries, so whether there has been any sort of compromised blood flow, because she says at night she did having this [...] pain, and that could mean a number of things, so I just wanted to know if there has been problems in terms of moving her knee, that’s why I asked her to do a few things, and only at one point she said ‘oh it’s painful’, but that’s because of the ligament tear, so after that I wasn’t really concerned that something is going wrong.**” (p#14)*

*“...I was feeling for the pulse as well, though there is the reading, **I want to know whether it is a regular pulse or irregular**” (p#14)*

*“...So this is me listening to his respiratory rate, **pretending to be feeling his pulse, because as soon as you tell someone that you are listening to their respiratory rate, it goes up or it goes down**” (p#13)*

The participants seemed confident in performing routine physical examinations. They seemed to know what they were looking for and how the examination results could contribute to their diagnostic process. They used physical examination in a diagnostic way to confirm their working diagnosis or to rule out serious differentials. When the students were performing physical examinations, they also seemed to be aware of the practicalities of the clinical skills. They show competency and awareness of how the examination should be performed in order to obtain valid results. They see these practical skills as part of the GP role.

*“...So I asked him if his pulse rate is usually quite high, because I was thinking please just be normal for him, because it’s a sign that he is really not very well if it’s that high, and then when I saw the number come out, which was 105, the first thing that is back to my head is pulmonary embolism, because it is one of the commonest things with it is that your pulse rate is really high and **then I kind of went, no** [name of the participant], because **actually the whole history**, it is a complicated one, the most complicated I have seen in six years to be honest, but it’s, that history **still points me towards something a bit more infectious**, and that would also make the heart rate quite high, usually quite infected by the time it starts to go up.” (p#13)*

The participants demonstrated being conscious of not judging examination results in isolation, but rather together with the history findings and the clinical presentation of the patient. This indicates the use of critical thinking and metacognitive strategies during the diagnostic process.

#### ***5.4.1.4 Atypical symptom presentation and co-morbidity***

Final year participants showed awareness of atypical cases and the possibility of co-morbidity. This shows a more advanced and realistic understanding of clinical presentations than in the case of fourth-year students.

*“... So **those are symptoms that patients would get if their blood pressure was really really high**, you get flashing of lights, dizziness, headache, but again **some patients, they won’t have any symptoms, they could feel perfectly fine**, but their blood pressure is really high, so I wasn’t surprised when he said everything no, I wasn’t surprised.” (p#14)*

*“... **in the past I have seen a patient who came in with malignant hypertension and he didn’t have anything going on**, and he was referred by his GP to go to A&E, and he, after that he, a day later he developed a stroke” (p#14)*

One of the students explained that having seen atypical cases in clinical practice means that now she can incorporate that into her diagnostic reasoning. She is aware that there

are often individual variations in symptoms relating to certain conditions and that simply the absence of a symptom typically associated with a condition does not mean the absence of the condition. This demonstrates a move away from the black and white thinking of less experienced medical students.

*“...so what my logic here was okay, if it was maybe a PE on top of an existing infection, **maybe there is more than one thing going on**...It’s me again probing about possibility of some super-added infection, something that there would be two things going on, I think **that’s what I am trying to get my head around this year**, you know if you ask a second year or third year, it’s very much they have pneumonia, whilst it could be that they have pneumonia and malaria or and PE, so trying to ask questions to really narrow it down, **see if there are two things going on, or one thing going on**” (p#13)*

The other student talked about considering the possibility of co-morbidity. He explained how earlier in their medical training, their thinking was characterised by considering one differential at a time, while during their final year of training they are starting to consider for the first time the possibility of co-morbidity. This implies a significant development in their diagnostic reasoning skills.

#### **5.4.1.5 Dealing with uncertainty**

Students experienced some level of stress and anxiety when they were faced with a case they could not solve. The participants used various strategies to cope with these uncertainties through the consultations, involving extensive documentation, safety netting and asking for help from the supervisor.

*“...as soon as I put my fingers on there [to feel the pulse], **it was really fast and a long swear word was going through my head at that point, and I was thinking oh god**, and then it felt like a very long time waiting for the number to come up on that screen actually.” (p#13)*

*“...Hot and cold **made me panic** that he might have TB or some other weird travelling infection.” (p#13)*

*“... with this patient I still haven’t homed my way down to a diagnosis, so all I know right now is, **I don’t know what you have got, but you are really sick with it, and that’s not a nice place to be**, and normally I could say, you have got this, and you are either sick or not, and I couldn’t do that this time.” (p#13)*

Being acutely unwell, the possibility of having a serious condition and being faced with diagnostic uncertainty all seemed to induce anxiety, panic or concern in the students.

These responses to the scenarios suggest the presence of empathy, at times intensified by a perceived inability to help the patient.

*“... I think the fact that I knew that he was a returning traveller quite **scared me**...I was just kind of thinking, please, just be a chest infection, don't be one of these other things, because **I wouldn't be able to tell you what they were.**” (p#13)*

*“...**Clutching on straws.** Looking for travelling infections, thinking about things like neurocysticercosis that take over the brain, just all sorts of things that come with dizziness, hearing problems, visual problems...” (p#13)*

The anticipation of being unable to identify the patient's problem induced fear in the student. Not having relevant experience or knowledge relating to the patient's problems was anxiety inducing. His comments indicate a state of desperation while trying to come up with a diagnosis. These suggest that it is important for the student to be able to come up with a diagnosis during the consultation.

*“... At that point I was thinking, right, **I don't know what's going on, so I need to at least document it thoroughly**, say what I could see and what I couldn't see, and then at least someone else can pick up...**just to be safe**” (p#13)*

When faced with uncertainty one participant found it useful to produce extensive patient notes, so that more experienced clinicians who will be managing the patient in the future can build on that information.

*“...ring your patient in two weeks' time, so that's **one thing I know what GP does is continuity of care**, so they would be like come back in a month or two or any point you feel unwell feel free to come in, stuff like that.” (p#14)*

The other participant highlighted the usefulness of the 'continuity of care' model of primary care which allows her to call back patients for check-ups or instruct them to come back when they feel unwell. This procedure helped her to overcome the difficulties of experiencing uncertainty in primary care.

*Researcher: “And anything you find challenging at this point in primary care?”  
Student: Umm, challenging, I would say some uncertainty, like if you get really dodgy ECG and you are not really sure, so I think, but [...] so in that way **I think even if it is challenging there is always a way out**”*

*Researcher: “Like a means to help you mean?”*

*Student: “Yeah”*

*Researcher: “So that's how you deal with uncertainty? That you ask for help?”*

*Student: “Yes, **ask for help**, yes, if you don't know, just ask for help.” (p#14)*

*“... **That's me thinking**... he is unwell, he has got quite a high temperature, and again thinking right, **time to call the GP in.**” (p#13)*

Finally, both participants found turning to their superiors for help as the ultimate life line when dealing with uncertainty in primary care. When they recognized that they are out of depth they did not hesitate to ask for help. Being able to admit readily that they are out of depth suggests the presence of a supportive learning environment.

*Researcher: "Do you generally discuss with the GPs their management?"*

*Student: "Anything, well **it depends**, because she comes and goes, one of the ones I had last week comes in and he lets the patient leave and **he sits with you for a few minutes and quizzes me**, so if it was anything like 'why are they doing that', I'll ask, so **in her case I know we are going out for home visits afterwards**, so we get a ten minute car journey after we have seen the patients, **so in that ten minutes I can ask her**. So I usually ask the same, things I can improve on, if there was anything that I should have asked or should have done differently, if there is anything that I doubt in management I can say, so I would say 'how come that you have prescribed [drug name] or [drug name] or something like that, I can ask though it usually.'" (p#13)*

Different GPs provide help and guidance in different ways during their clinical placements. While some provide immediate feedback, others leave it to the student to ask questions if they want at the end of the surgery.

#### **5.4.1.6 Content dependent management skills**

Generally, the participants seemed to be confident in managing patients' problems in primary care, which is a marked improvement from their fourth-year consultations.

*"...usually by the time I get together the history, I know what they've got"  
(p#13)*

*"...I was thinking right, **I can do initial management fairly well, but what do you actually have?** What's the underlying process here? Is it bacterial? Is it viral? Because you are going to treat those very differently, so then I believe I checked his throat next, and then I check his sore throat to see if there is any exudates, just to see if there is any inclinations that there is something bacterial going on." (p#13)*

*"...it's just when something like this comes in and it's still **vague** but it's **fairly bad**, that's when it's a little bit, well **a lot more challenging for someone at my level I think**." (p#13)*

One participant was confident in his skills of identifying patients' problem based on history and work out a management plan most of the time. However, at times not being able to pinpoint the exact underlying biomedical process and cause of the symptoms hindered his ability to work out the best route of management. He found cases that are both vague and severe to be the most challenging to diagnose and manage.

*“... I don't know malaria, because I never really, I never seen it, it's not something we focused on, so could this be malaria, if it is, I was thinking, I have no idea how to manage it” (p#13)*

At times, students were faced with illnesses in primary care that they had no knowledge of. When the participant did not know how to approach such case with regards to management, she turned to her supervisor for assistance. This indicates that even in final year, there is a content dependency relating to management skills.

*“...I would have escalated it in another direction, I would have escalated I think maybe, probably should, yes give him some antibiotics, but probably I would investigate further today, rather than give him some antibiotics and come back next Monday, if it not works, so I find that he was sicker than that and that there wasn't much leaning me towards a bacterial infection, but I think everyone will make that clinical judgement based on the experience they have had.” (p#13)*

*“...I think I said later, could a chest X-ray be useful in any way, and I think she said maybe later down the line, so it seems as if, it comes down to the uncertainty in GP I guess, this patient, I would have escalated it in another direction” (p#13)*

*“...because in the past I have seen a patient who came in with malignant hypertension and he didn't have anything going on, and he was referred by his GP to go to A&E, and he, after that he, a day later he developed a stroke...So I was a bit, that's what I have seen, but obviously the doctor, he has seen a lot of other patients as well, so yeah.... Yeah, and [...] I don't know how big of a problem this was until Dr [...] came in and he explained. But in the past, I had seen patient who had stroke because of high blood pressure, so I just wanted to be almost just on the safe side.” (p#14)*

The above extracts indicate that students and their supervisor can have very different ideas about what is the most suitable management plan for the patient. In these cases, both participants claimed that they would have gone with the more secure management option including referral for further investigations, while their supervisors suggested against it and decided to manage the patients without referrals and further investigations. Students themselves attribute this difference in judgement to their clinical experience. One student suggested that it was due to her supervisor having more clinical experience, while the other student suggested it was due to her supervisor having different clinical experience. The former suggests that it is the amount of clinical experience that matters, while the latter emphasizes the idiosyncratic nature of clinical experience and its influence on clinical judgement in face of uncertainty in primary care. It may also be due to students not having much experience with clinical uncertainty or having a lower risk tolerance than their supervisors.

#### 5.4.1.7 Patient-doctor dynamics

During the primary consultations, students were making metacognitive remarks about the psychological side of the consultations, analysing the patients' behaviour and their reaction to those.

*"... me discussing that there was my way of **getting him on the same page as me**" (p#13)*

*"... I started to think maybe he thought that **I am waffling** or moving around and not quite on path with him, so I tried to explain what my logic was while I was asking some of the questions" (p#13)*

*"...I wanted to ask her, what do you want us to do for you at this point, because some patients do have an idea that they want the doctor to do so and so, so I thought of going with that approach, what can we do for you, instead of me listing down things that we want to do, but she is not interested." (p#14)*

The students talked about the importance of achieving mutual understanding with the patient, and actively involving them in the selection of the management plan during consultations. One participant found it important to explain his line of reasoning for the patient in order to maintain the appearance of a competent clinician. The other participant suggested that patients often know what kind of management they want when they visit the practice, and asking explicitly about their expectations can contribute to patient-centred care.

*"...he knew he was unwell, but I think subconsciously what was going on here was that he was looking, he was, talking in terms of psychotherapy...it was **almost like a compliant, nervous child, looking for a nurturing parent to convince him that everything was okay**, I wasn't going to let myself slip into that nurturing parent role, **I wanted to stick into a very adult conversation, and had to blink my ears and my vision a little bit at this point**, because I could tell, that it was going to go down that route if a didn't control it a little bit, and get the further necessary information beyond saying incorrectly, maybe it is heat exhaustion" (p#13)*

*"...At that point I very much clocked that he was trying to, I felt that **he was trying to convince me to convince him that he just had heat exhaustion**, because he came up a few times and he kept saying "oh I was just getting overly hot", and **I was kind of mentally safeguarding myself from entering that path**, because I knew there was something more going on based on the history, he has got a cough, all these things that don't happen with a heat exhaustion, so at that point **I was purposefully trying to tunnel vision myself past those comments**" (p#13)*

When dealing with a reassurance seeking patient, the student explained how he was consciously analysing the patient's behaviour during the consultation and reacting to it accordingly. The patient was looking for reassurance, however, the history suggested that the possibility of a serious condition. The student experienced an urge to help the patient which suggests an automatic empathetic response. However, at the same time he was aware that reassuring the patient at this point would be premature. He therefore engaged in a behavioural coping strategy whereby he was focusing his attention on the computer screen. By directing his attention away from the patient, his coping strategy helped him to deal with the pressure of the situation. His reflections suggest conscious awareness of the psychological dynamics of the consultation.

#### **5.4.2 Training and preparedness for practice**

During the interviews, participants made comparative comments between their undergraduate training and their behaviour in the real clinical environment. They have highlighted some areas of clinical skills where they felt further training could be useful. Finally, their accounts suggest that while primary care placements tend to be quite heterogeneous based on the practice and their clinical supervisors, it is a speciality where they can practice a wide range of focused diagnostic consultations.

##### ***5.4.2.1 Medical school protocol versus real practice***

Participants have highlighted various aspect of clinical practice that they perceive to be different in reality from what they are trained to do in medical school.

*“... So, usually, for like exams we do have a list of questions that we just ask, but of course **this is not an exam**, and this is like a **continuity of care**, so you **don't want to just bombard them with irrelevant questions**, but just to know a bit about what she does in her life, you know, she feels stressed or not, based on the activities of her life, so that's what I ask her those questions” (p#14)*

One of the participants explained how their approach to a real diagnostic consultation would be different from that of an examination scenario. Her account does not only suggest that she finds some of the questions she needs to ask during an exam irrelevant, but also that she would not ask all those questions in real life. She feels like during exams they are asking patients a large amount of potentially irrelevant questions in quick succession (i.e. “bombard them”). In real practice they tend to have a much less pressured approach. They tend to be more patient centred, showing empathy towards the patient and acknowledging that the patient may find a high number of questions in a short period of time overwhelming. She appeared to have a more holistic approach to

the consultation instead of focusing on the list of questions they are supposed to ask in exam situations.

*“... I was asking **some of the questions**, because things like allergies, drug history and the like **are quite abrupt and quite tick boxy** and I think is **very off topic** to what you were just describing, so I think **a lot of GP consultations they don't, I have noticed, they don't ask that until they sign the prescription** if they have an allergy, but I like to do that earlier because **that is the way I have been trained** and I feel like because it's quite abrupt, **I do like to talk to them about it and tell them why I am asking it**” (p#13)*

The other participant talked about the perceived difference between the ways experienced GPs structure consultations and what he was trained to do in medical school. He found certain questions that they are trained to ask rather “tick boxy” and “abrupt”, which made him feel the need to explain the patient the reasoning behind asking those questions. However, instead of adopting the experienced GP's approach that he observed in real practice, he decided to stick with the structure taught in medical school despite having to justify their questions.

*“... I throw that out in every consultation, because that is what we are trained to do in medical school, realistically I have never seen it, **I never ever seen any of the qualified doctors approach the ideas, concerns and expectations**, I still do because I still have time to, however, **I don't think I have ever seen it be of benefits** thus far, 99% of patients will say, you are the doctor, or you are the medical student, but I thought it was worth a try.” (p#13)*

He was also pointing out that he does not see experts using the same questions during consultations that they are trained to ask in medical school. Nevertheless, the student was still asking those questions, even though he did not find them useful. He explained that he was asking these questions, only because he had the time to ask them. However, this suggests that once he will have more limited time in later years he may stop asking those questions.

#### **5.4.2.2 Preparedness for practice**

Participants felt that there were certain domains of knowledge and skills where they would require further training and practice.

*“... we are trained very much towards **common things** are common and **what happens in the UK and little addendum with other weird and wonderful things that come with travellers**” (p#13)*

One participant pointed out that medical school prepares them for common illnesses and illnesses that are typical of the UK, but leaves them relatively unprepared for illnesses that are common in other regions. However, in general practice they do sometimes come across these rare illnesses which can be challenging for the students.

*“... there is a lot of skills that we are not very good at, I think respiratory rate is one that I can't really do reliably, and it's really obvious, looks a bit creepy when I try to do it, I stare at someone's face and listen intensely and look at my watch...I don't see doctors do it either, I think our profession seems to be moving away from those basic skills and handing them to nurses, which is great if you have already spent years doing those skills, but if you haven't, it can be quite awkward. The rest of them, you pick it up, because you do do them, the respiratory is just the one that is just awkward to measure, because you really can't tell someone what you are doing, or they will change it, they will become aware of their breathing and so it's a weird one to work around.” (p#13)*

*“... Something about being a GP as well, I am really bad at remembering what you are actually doing in terms of someone's observations. I mean in hospital I don't think twice, I mean I go like pulse, blood pressure, saturations; in GP it just doesn't click for me, I think because GPs don't do it. I never see a GP do blood pressure. And so things like that I have to consciously, so I am typing there and I am thinking, 'what am I doing next, what am I doing next?' – that's the only part that really stumped the consultation for me that first bit in the examination, remembering exactly what I have to do in terms of the observations.” (p#13)*

One of the students also pointed out the importance of training medical students in basic clinical skills. He perceived a change in healthcare practice whereby some of the basic physical examinations are increasingly done by nurses instead of doctors. According to him, this change does not affect experienced doctors that are already in possession of those skills, however, can present a challenge for medical students. The student was also less confident in knowing what physical examinations they need to do in primary care, while he had no such problem in secondary care. From his account it seems that he doesn't see experienced GPs perform certain physical examinations which makes him conclude none of the GPs are performing them. This demonstrated the power of observational learning and how observing the behaviour of real clinicians can conflict with his formal training.

*“...I think it was more like **administration work**, you know the note and things like that, and I don't have the authority to do that” (p#14)*

*“...I know generally what a sick-note is for, but what **she wanted was fitness-for-work**, so I wasn't really sure, how to go on with that” (p#14)*

*“...At this point I don't know no what was going on, **I really didn't know, because I don't have access to the hospital letters**” (p#14)*

One student found it challenging to deal with the administrative duties of primary care work. She explained that during the placements they have limited access to various hospital resources, which prevents them from practicing certain administrative aspects of the primary care work.

#### **5.4.2.3 Primary care as training ground**

The student's account suggests that primary care is an ideal setting to prepare her for her final exams.

*“... I really like it, and because I am having exams next month, and because this is my last rotation, it is quite good to have a nice wrap up, because **you see a lot of things, you see heart stuff, kids, paediatrics, and then you see like bowel things, and things like that, cancer...**, and the thing is **you don't know what's coming in**, so that's quite, in a way that's quite exciting as well, because you want to think so yeah, I want to say that it is **good for exam practice** because it is **very focused**, you don't want to spend a lot of time, in hospital you have got half an hour for each patient, but here you don't.” (p#14)*

The students pointed out that in primary care they see a wide range of patients, they need to perform a focused consultation under limited time, and there is an element of surprise with the consultations as they cannot anticipate what the next patient will present with. These features are similar to those simulated during final year exams and therefore provide a good preparation for that.

*“... **in fourth year I just see them and I examine and I wouldn't come up with the management**, you are not, well you can come up with, but they don't really expect you to do so.” (p#14)*

*“... **here you sit in for a week, you kind of learn how to do everything on the computer**, things like that, then you get, you don't get your own set of patients, but you get to **take from the on-call GP, the patients**, so I feel a bit of **responsibility** when I see them...you talk to the patient, examine, and then when you go to the doctor, you present how, **you present like in detail, and then this is my diagnosis and this is what I want to do.**” (p#14)*

The student described how their clinical placements in primary care were different in year 4 and year 5. In year 4, they had a passive role in the diagnostic process, they were not yet given much responsibility, and they were not expected to come up with a diagnosis or management plan for the patients they saw. Their only task involved history taking and examination of the patients. On the other hand, during their final year

placements, they take a much more active role and gain experience in the diagnostic process from start to finish.

*“... Depends on which GP, she does the management parts, one of the other ones makes me do all the management parts, which today I would have struggled with, with that patients, generally it is fine, so when I am with her, with this GP, generally, she would ask me a question or two and then she would do the management plan... so they are all a little bit different.” (p#13)*

During their clinical placements, different supervisors give them different level of responsibility in formulating management plans. There are ones who prompt the student to be actively involved in the management plan while others take over the leading role and make the management plan themselves. This suggest that students may be exposed to different levels of responsibility and practice during their clinical placements.

## 5.5 PHASE 3 – IPA FINDINGS

Similarly to phase 1 and 2, reflective interviews were transcribed by the researcher then the transcripts were analysed using IPA process of Smith, Flowers, and Larkin (2009).

The analysis of the reflective interviews revealed three superordinate themes and fourteen subthemes (See *Table 8*). The superordinate themes were (1) diagnostic reasoning, (2) strong consultation skills, (3) and patient-doctor dynamics.

The first superordinate theme involved the participants' perceptions of the diagnostic process in primary care, and their diagnostic strategies in primary care. The second theme described the interpersonal and communication skills of foundation trainees and their use of online resources to facilitate the consultations. Finally, the third theme described the complex patient-doctor dynamics in primary care consultations experienced by the trainees.

*Table 8: Themes based on the interviews with Foundation trainees*

### **Superordinate theme I – DIAGNOSTIC REASONING**

- Theme I – 1. Preconceived ideas
- Theme I – 2. Decoding the patient's story
- Theme I – 3. Driven by history, clinical presentation and clinical judgement
- Theme I – 4. Red flag questions in primary care
- Theme I – 5. Ordering diagnostic tests and test of treatment
- Theme I – 6. Dealing with uncertainty
- Theme I – 7. Management over diagnosis
- Theme I – 8. The role of experience

### **Superordinate theme II – STRONG CONSULTATION SKILLS**

- Theme II – 1. Using open-ended questions and active listening
- Theme II – 2. Using online resources

### **Superordinate theme III –PATIENT-DOCTOR DYNAMICS**

- Theme III – 1. Rapport building and empowering
- Theme III – 2. Shared decision making and negotiations
- Theme III – 3. Avoiding blame and frustrating patients
- Theme III – 4. GP role

### 5.5.1 Diagnostic reasoning

The diagnostic approach of Foundation year participants was characterized by a greater level of reflection than in case of undergraduate students based on the present study. They showed more awareness of cognitive predispositions and metacognitive strategies to counteract those during diagnostic consultations. They paid attention to clarifications with regards to patient information. They used red-flag questions less frequently, based on their clinical judgement. They were confident in ordering diagnostic test, using the test of treatment, and thereby allowing the diagnostic process to take multiple follow-up consultations when necessary. They seemed to place a higher emphasize on managing patients over pinpointing the precise diagnosis of the patient. Finally, their accounts suggest that the lack of experience with an illness can hinder the diagnostic ability, while overfamiliarity can lead to superficial use of physical examinations.

#### 5.5.1.1 Preconceived ideas

Before the start of the consultations, the participants were often aware of the presenting complaint of the patient they were about to see.

*“...Yeah, so you can see that on the note that they are coming in with back pain, that is the reason why they wanted the appointment. So, I think even before you start you sort of know that it is going to be probably just a bit of mechanical, ‘I have had an injury’ sciatica” (p#15)*

Seeing the presenting complaint often triggered automatic diagnostic ideas for the clinician even before seeing the patient face to face. This cognitive pattern was most typical of consultations where the patient was presenting with a symptom that is very common in primary care, such as back pain or a cough.

*“...patients often come in with a single problem and you often have a very preconceived idea about what their, what their final diagnosis is, um and it’s often a little bit, you have to remind yourself that yes it is your initial thought process, but when you don’t subsequently find it in your history and then in your examination, I think that is the most important part” (p#16)*

These initial thoughts were labelled as “preconceived ideas” by one of the participants. His choice of words suggests conscious awareness that these initial ideas are formed prematurely and based on limited information. His account suggests that using metacognition to override the initial urge to diagnose the patient based on the presenting complaint is an important part of the diagnostic process. The participant recognizes the importance of collecting supporting evidence through history taking and physical

examinations to test those initial, tentative ideas. This conscious awareness and the use of metacognition as a cognitive self-regulation technique can help prevent cognitive errors such as premature closure or confirmation bias.

*“...you have to sort of **remove a preconceived idea**, because often when someone says they have got really itchy, dry hands, **my head automatically goes to, my God, is this the next scabies? Is this something that is going to be contagious? And then you just have to have a look at it and then you go, actually, it has been there for 8 months, it looks more like this and that, what’s the more plausible thing, he works, I mean he mentioned that he works as a driver, so he hasn’t got a risky occupation in particular to get something like scabies. And the most itchy parts were not where scabies normally affects, so normally, he has got itchiness on his palms of his hands, which looks more like a type of dermatitis, like a hand eczema to me”** (p#16)*

In the above example he is describing how the initial diagnostic idea (i.e. scabies) is entering his mind automatically, without conscious effort which suggests that it is a non-analytic cognitive process. However, as opposed to pattern recognition where the illness script is activated based on the clinical picture, here the automatic idea is based on a single symptom. He describes overriding this automatic thought with his analytic reasoning, by considering onset, course, associated symptoms, symptom presentation and the presence of risk factors. Based on the information collected he decides whether the initial diagnosis or a differential diagnosis is more plausible.

*“...I think when someone initially says, I have got itchy hands, my **first one is like, what’s the worst thing it’s going to be? And it tend to be how I work in general diagnosis, so what is the absolute worst thing it’s going to be, and then I work my way backwards”** (p#16)*

*“... I think **when anyone comes in with a cough, you think oh they just got a simple virus and then it is just making sure that you have covered red flags”** (p#15)*

There are two different approaches here with regards to their initial automatic diagnostic thoughts: one of the participants was automatically thinking of the worst-case scenario, while the other participant was thinking of the most common, benign differential related to the presenting complaint. Interestingly, this distinction between the two participants was present in all of their consultations, suggesting a persistent pattern, perhaps relating to personality traits.

*“...I have become more aware of it since doing this rotation, certainly **in hospital medicine you can get very carried away with your preconceived idea and actually it’s, you can run with it sometimes and it doesn’t get picked up on***

*as quick as normal, but after you know being **in general practice** for a bit and seeing you know how the GPs consult, you know, **having other GPs assess my consultation**, it's interesting to see what they see" (p#16)*

One of the participants also describes how dealing with 'preconceived ideas' can be influenced by the setting. According to him, it is easier to get carried away with preconceived ideas in hospital settings, but less so in general practice due to being assessed by other general practitioners in the practice. This explanation suggests that besides using metacognitive strategies, having a second opinion from more senior colleagues can be an effective cognitive de-biasing strategy. Based on his account, the supervising GPs in primary care setting offer their point of view, which can challenge the junior doctors' preconceived ideas and thereby promote safer clinical practice. This highlights the importance of supervision and revision of consultations of junior doctors in order to avoid diagnostic errors.

*"... **this was a new patient to me, I had no idea what he was coming in with, so could have been anything under the sun**" (p#16)*

*"...**you look at past records, as best as you can and I try to do it at any placement that I am on, and there was nothing really on his record, he hasn't been to the GP for about a year and a half, so it makes, in your mind you know, it's probably, I guess if someone has not been there regularly, you in your mind you think it's something acute that is bothering him, something that is new, that's bothering him**" (p#16)*

At times clinicians do not have access to the presenting complaint before seeing their patient face to face. However, even in those cases, the clinician may have access to previous patient notes which trigger automatic assumptions about the patients' problems. In the example above one of the participant was making assumptions about the nature of the patient's problems based on the previous patient records. He is also making use of semantic qualifiers, which is indicative of forward reasoning strategy. The formation of initial diagnostic ideas appears to be an automatic, general cognitive strategy to prepare for the consultation and it shows that the diagnostic process starts before even seeing the patient.

### **5.5.1.2 Decoding the patient's story**

It was clear from the interviews that when the patient shares their story with the clinician during the consultation, one of the first tasks of the clinician is to understand

clearly what the patient is trying to convey and to decide which pieces of information are relevant for the diagnostic process.

*“...it is **difficult to try to pick apart what patients come in with**, so they tend to come in with one problem that seems relatively straight forward, but they have got several other things that they want to tell you that you have to sort of pick out from them” (p#16)*

One participant talked about how patients often talk about several different issues when presenting their problem, and therefore de-coding the patient’s story can be a challenging part of the diagnostic process. In order to progress with the diagnostic process, the clinician first has to separate significant information from background noise in the patient’s account.

*“... It was when she said the words allergies, you have to ask what she actually means... I thought I knew but I think you always have to ask, because obviously **different things mean different things to people**” (p#15)*

*“... I think really, what I felt for her was, she was quite, she said she was breathless and it is something that I have to, obviously I have to qualify it, because she was still sort of walking around, still doing her normal things, so I wasn’t really too worried. **I think patients often say breathless when we don’t really mean that.** So yeah, I think that’s why I had to ask her maybe a few more questions than I usually would.” (p#15)*

The above quotations show that the participant is consciously aware of the need to clarify what the patient means when talking about their problems and recognizes that patients may be using medical jargon incorrectly which could lead to misunderstanding between the patient and the doctor. The participant also stresses the importance of qualifying the patient’s symptoms. Qualifying symptoms is necessary for translating lay terms accurately to medical terminology which in turn leads to a more abstract representation of the patient’s problem.

### ***5.5.1.3 Driven by history, clinical presentation and clinical judgement***

One important feature of primary care consultations that was identified by the participants was that the diagnostic process is heavily reliant on history and clinical presentation. Participants also emphasized the use of clinical judgement as an essential part of the diagnostic process in primary care. Clinical judgements are decision at which the clinician arrives at based on various sources of information.

*“... I am relying so much on my history and so much on, you know, how she is coming clinically” (p#16)*

*Researcher: “And how do you find the diagnostic process in general practice?”*

*Doctor: “Umm a lot of it is very history driven, so you don’t have all the routine [tests], you don’t have the tests that you might necessarily have in a hospital for example, so in a hospital you can do a blood test, you can do a chest X-ray, you can do everything very quickly, you can get the results back in an hour, and in general practice, someone comes in with a clinical problem, you have to listen to the history, examine them, yes you can order x, y and z, but they might take time to come back” (p#16)*

The participants point out that being dependent on history and clinical presentation is due to the limited resources in primary care setting. In a hospital setting, others diagnostic tools such as blood test and X-rays are readily available that can aid the diagnostic process. However, primary care clinicians need to make diagnostic decisions before the results from such tests could be obtained. This way the setting and the availability of resources influences the diagnostic approach of the clinician.

*“...your history is very important, probably more so, more important because you have got nothing else to rely on, you have nothing to go on ‘oh you saw so and so on you know a week ago, have you been better since then?’, you can’t really rely on a previous history, you really are seeing the patient from scratch” (p#16)*

The clinician is even more reliant on the history and clinical presentation when there is no previous patient record available. Here the participant explains how seeing a new patient like that means that the clinician has to start with a clean slate without any previous information. In such consultations uncover all relevant information through the history taking is key.

*Researcher: “When you are exploring his pain symptoms, you know how medical school students often use the SOCRATES to know what to ask, do you think you still use those questions or not anymore?”*

*Doctor: “I think it helps to know whether it is a dull pain or sharp pain, because that indicates whether it is nerve pain or not. I think because he said it was dull, but sometimes got a bit sharp, then you sort of know. I think I do ask sometimes if the pain is radiating anywhere else, but I usually just point and ask is it going here, or is it going there? Yeah, I think you do get out of it, because when you realize what is wrong, you don’t really need to stick to it. Yeah, I think you do it without realising it now.” (p#15)*

When exploring patients’ symptoms, medical students often relied on mnemonic devices such as the SOCRATES in order to aid the recall of all potentially relevant questions. As opposed to that approach, this foundation doctor explains how she

stopped using such mnemonic device without being consciously aware of it. She is not using the mnemonics device anymore, instead she is asking questions that she thinks are relevant for her diagnosis and is aware of the diagnostic implications of the answers to those questions. It shows flexibility of thinking and demonstrates a good understanding of the relevance of the questions used during history taking.

*“... I think that is the most important part, in all of medical specialities it is the most important part, so the history taking, examination findings, but more so in general practice, because it is what **you heavily rely on is your clinical judgement in that situation.**” (p#16)*

*Researcher: “How do you usually rule out those very serious ones?”*

*Doctor: “So, either it’s, **either it’s various different tests that I order**, or it’s like a clinical thing, so if I **look at it and I just judge it to be**, you know, something that is more minor” (p#16)*

*“...I am a junior, I think the other **GPs probably feel a bit more**, because they have **got more experience** they probably **know when someone is not unwell**” (p#15)*

The participants suggested that primary care involves the use of clinical judgements more so than other speciality settings. Being more dependent on their clinical judgements implies more perceived uncertainty in the primary care setting compared to other specialities. The participant’s account suggests that clinical judgements in primary care are made based on three elements: information gathered through history, physical examination findings, and the clinical presentation of the patient. The latter involves decisions based on the general appearance of the patient which can in turn influence the clinician’s decision on whether to order further tests. As a judgement is based on physical appearance, it may be seen as a subjective element of the diagnostic process. It is suggested that having more clinical experience helps making more accurate judgements based on the patient’s appearance.

*Researcher: “And how do you find the diagnostic process in general practice?”*

*Doctor: “... **you rely a lot on your clinical judgement** which is interesting, and I think it is the fun part of general practice.”*

*Researcher: “It is the fun part?”*

*Doctor: “Yeah, I think **relying on your clinical judgement** you know it **makes you feel like a doctor.**” (p#16)*

Based on the participant’s account, using clinical judgement is an elemental part of their professional identity. The participant states that being dependent on his own clinical judgement is a core skill that makes him “*feel like a doctor*”. Making clinical

judgements is a cognitive process that involves forming clinical opinions based on the available information. Such judgements are the basis of clinical decisions through which the clinicians select a certain route of action from the existing alternatives. Hence the judgement carries the responsibility of clinical actions that will determine patient management. Such responsibility is the exclusive right of qualified professionals, and hence linked closely to professional identity.

*“...but he just **looked really well**, so yeah I **didn’t think it was anything serious**” (p#15)*

*“...if someone comes in with multiple different problem, my initial thought is, you know, it’s normally nothing, if it’s, if it’s they are a young patient for example with a hundred different things wrong with them, it’s often nothing, it’s often their own sort of driven problems that they have created themselves and actually you then have to think about what’s the underlying cause for all of that, that’s it, it’s **going back and reminding yourself that you might need to dig a bit deeper** into understanding why a patient come in with a certain thing” (p#16)*

Making judgements based on the general appearance of the patients formed part of the diagnostic process during the consultations. However, making judgements based on clinical presentation can be subject to common cognitive errors, such as representativeness error whereby doctors may judge someone not to have a serious underlying condition when they appear healthy and well during the consultation. As clinical appearance can be misleading, such approach carries the risk of diagnostic errors. One way to avoid such representativeness bias is by using metacognitive strategies that can prevent the clinician from jumping to conclusions too soon. This is demonstrated by the participant in the second extract, where he explains the importance of consciously reminding himself of not to draw premature diagnostic conclusions.

#### **5.5.1.4 Red-flag questions in primary care**

Both participants talked about and demonstrated the use of red flag questions during the diagnostic consultations to rule out the most serious conditions.

*“... I think when anyone comes in with a cough, you think oh they just got a simple virus and then it is just **making sure that you have covered red flags** and that you know that they are going to be okay when they go home.” (p#15)*

*“... I think with the shortness of breath I was, I was thinking there may be another cause, that is quite acute, and she has got a cough and **I did check her legs to make sure that she doesn’t have any swelling** or anything, and that’s why I asked her to come back if she is not getting any better, because it could be something else.” (p#15)*

*“... I was thinking like, obviously **you want to rule out whether he has ruptured the membrane**, because that would be the biggest thing” (p#15)*

*“... it’s a **very odd presentation**, so you start thinking of all the weird and wonderful things, and certainly my initial consultation with her, **I did a very long red flag history**, I asked about red flags from the point of view of her stomach, from her oesophagus, weight loss, red flags with hoarse voice” (p#16)*

These extracts show that both common and odd symptom presentations trigger the use of red flag questions. Their comments indicate that they find the use of these questions important for the diagnostic process. They are using expressions such as “*making sure*”, “*I did check*”, “*want to rule out*” and “*certainly...I did a very long red flag history*” which are all indicative of significance and emphasis. However, this attributed importance to red flag questions was only present in half of the consultations. In contrast to the comments above, later on in the interview both participants expressed that they do not find it always necessary to cover red flag questions. In the extracts below they offer two different explanations for this.

*Researcher: “Were you looking for anything that could be red flag in this case?”*

*Doctor: “Do you know, I wasn’t very good at my red flags, I think I asked one red flag at the end. **I think in GP you don’t**. When I was at **A&E I used to ask them all the time**, you know, because you have to be safe, and I think really if he had problems with his bowels or weeing or he couldn’t feel his bum then **he would have mentioned it**. Yeah, **I should have probably asked him**. Because **people always look at you like really strange when you are asking them those type of questions**, like ‘it is not even related to my back’” (p#15)*

From this account it seems that while acknowledging the need to ask about red flag symptoms, the clinician fails to check them in an attempt to avoid an anticipated negative reaction from the patient. Her account also reflects that she thinks that patients would disclose these serious or worrying symptoms independently without having to be explicitly asked about it. She finds that the red flag questions here are too abrupt and patients would not understand why they are being asked those questions. She also emphasizes the importance of the setting again and how it influences her diagnostic approach. She is explaining how in an A&E setting the priority is to be safe and therefore she would ask every relevant red flag question irrespectively of the patient’s reaction. However, in primary care the patients’ negative reaction seems to act as a deterrent for asking intrusive questions.

*Researcher: "How did you get to that question?"*

*Doctor: "I think as I was looking at the leaflet, and I thought, actually, I have not asked him any red flags, which is why I just tacked one on at the end*

*Researcher: And you have asked that one because?"*

*Doctor: "I think that is the easiest one, I think when you ask people with back pain about their bowels they are like 'why are you asking me about that?', it is something personal, so yeah, but in A&E I did ask all of them, but it's just, I think in GP you just, he is just not likely that he has got spinal cord compression, yeah" (p#15)*

The participant is again emphasizing the point that she would cover all the red flag questions in a hospital setting, but not in a primary care setting. When addressing red flags that are sensitive in nature, she is trying to minimize the patient's anticipated discomfort by asking the least intrusive question from the red flag list. Her account suggests that it is the setting that has a direct influence on her diagnostic approach. Her account also suggests that those questions have a higher priority in A&E, where they should never be left out. In the extract below, the other participant offers a different explanation for not always covering red flag questions in primary care.

*Researcher: "In this consultation, were there any red flags that you need to check or that you were worried about?"*

*Doctor: "No, not particularly, I didn't, in fact I didn't directly ask about red flags, um but I didn't feel that that's the way the history was going. And often patients are the first people to tell you if there is something serious going on, he came in saying 'I have got hay fever and I have got this with my hands'. And this is two relatively straight forward diagnosis which is quite nice, but also if someone comes in with a really obscure symptom, or you know 'I have had abdominal bloating for 8 months', you start thinking oh maybe it's something else, maybe we need to do a little bit more, maybe I need to ask a bit more, but for him, I didn't feel the direct need to ask about red flags, because he knows, he knows what's going on, you can see, he is actually partially treating himself anyway to some affect, so it's more reassuring for me to then go right, let's just optimize you as best as we can on your treatments that you need." (p#16)*

According to his account, it is acceptable to leave out red flag questions when the unfolding history does not suggest the possibility of a serious condition. According to him, in consultations with simple, straightforward diagnosis, there is no need to go any further into possible red flag symptoms. On the other hand, if a patient presented with a red flag symptom to start with, that would require further investigations in that direction. He also shares the opinion that patients would disclose serious symptoms without having to ask them.

### 5.5.1.5 Ordering diagnostic tests and test of treatment

In cases where the history and clinical presentation do not provide sufficient information for the clinician to define the patient's problem, they turn to ordering diagnostic tests to rule out further differentials.

*"... I asked every single red flag question last time, so this time it was more sort of right, **you don't have any red flags, I have run some blood tests to rule out the most severe things**, if that's normal then I'm not out of options, but it is pointing towards a psychogenic or anxiety driven problem rather than anything else" (p#16)*

*"... **you think of the worst and you hope for the best**, and that's the **balance you play with in general practice**. And I think, you know, doing those there is nothing much more, test wise nothing much more I want to add, we did a chest X-ray for her that was normal, the blood sample was normal, so you start thinking what's going on, tell me a bit more" (p#16)*

Once the participant has exhausted the red flag history, he then moved onto ordering tests to rule out further serious differentials. He started with ruling out the most serious differentials and then moving down the ladder towards the less serious ones, with psychosomatic illnesses at the bottom of the list. He also talked about balancing serious and benign differentials in primary care. His account suggests that he is aware of the importance of thinking of and ruling out any serious differentials before being able to conclude a more benign diagnosis.

*Doctor: "... one was a urine test, which was a **24-hour urinary collection test**, and one was a **blood test**...the urine test was a very specific test to look for any problems with his adrenal glands, because his blood pressure in the past was so poorly controlled that you start thinking about other causes for why the blood pressure is up, rather than just being an essential hypertension... so my initial, one of my differentials in my previous consultations was whether this was hypertension caused by something wrong with the adrenal glands, so like a *Pheochromocytoma*, or whether there was something wrong you know with his arteries, which is, he **had an ultrasound scan** before that as well which was normal, so **we ruled our sort of the most common or obvious causes** why you have really high blood pressure that is not controlled."*

*Researcher: "Okay, so given those test you can rule out"*

*Doctor: "**I can rule out**, yes, that there is something wrong with his adrenal glands **with confidence**." (p#16)*

*Researcher: "Is there anything that is not supporting the hypothesis?"*

*Doctor: "No, I don't think, I mean **everything just points towards it**, just **having negative results on everything**, so his ECG is normal, his stats are normal, his bloods have been normal, his urine test have been normal, every, all sort of avenues that we normally go down are all normal, so you know **it has to be something extremely rare that we haven't picked up on**, if we didn't pick up on anything" (p#16)*

In the above quotations the doctor is again talking about using various tests to rule out some of the most common causes for the presenting complaints. He keeps ordering various test until either a positive test result is found or the resources are exhausted. He uses negative test results as a reliable source of diagnostic information, however, he does not mention the discriminatory power of negative tests that may be relevant for his diagnostic decisions. On the other hand, he does vaguely refer to pre-test probabilities of diseases in primary care by acknowledging that there may be differentials with very low pre-test probability that could be missed in the diagnostic process.

*“... So yes, this was a patient that is well known to me, who I have seen three or four times in the past with poorly controlled blood pressure, and this was an appointment that I planned to see him. So I always tend to, when it is a **planned appointment** that I see, I tend to jump in with my hat on first and say right, this is what I want to talk about with you. Um and I think I try to give a patient the opportunity at the end to say ‘is there anything else that is going on, tell me, and then we can deal with that problem as well’. But if it is a pre-booked appointment with me, I tend to jump in with my idea first” (p#16)*

Once diagnostic tests are ordered, the diagnostic process may last long over several consultations and call-backs to the practice. Once the diagnostic process enters this phase, the nature of the consultations changes from exploratory discussions to planned, focused meetings. The participant described how these consultations tend to be more directed by the clinician’s diagnostic ideas in order to progress the diagnostic process, while the patient has a more passive role throughout the consultation.

*“...Yes, so I think it is important to follow up, especially in this sort of initial phase of having a diagnosis, **a lot of time a treatment is not just therapeutic, it’s diagnostic.** And you have to sort of use what you can get” (p#16)*

*“...he **responds to treatment** now, so it **suggests that it is the correct diagnosis**” (p#16)*

*“...I tend to go with the more minor thing first and also actually **what is the easier thing to treat.** If it’s, **if it’s scabies for example, my treatment will have no effect on it, he is going to come back in two weeks. If my treatment has worked, it’s confirmed my diagnosis,** so a little bit it’s let’s try what’s common first, common things being common, let’s treat that first” (p#16)*

The final stage of diagnostic testing is through the ‘test of treatment’. When there is sufficient evidence to form a management plan, but there is still uncertainty about the diagnosis itself, the effectiveness of the treatment can inform the clinician about the

correctness of the diagnosis. When using test of treatment, the participant is starting with treatment for the most ‘easy-to-treat’ differential which requires the least intrusive treatment. When the treatment is ineffective, the clinician anticipates that the patient will return for a follow-up appointment which in turn will refute the previous diagnosis.

*“...sometimes the GPs don’t know what is going on, and then really what they do is just ask them to come back, so just saying you know ‘we try that, if it doesn’t work, come back’” (p#15)*

*“...it just seems like **trial and error**” (p#15)*

The other participant perceived the use of ‘test of treatment’ as a trial-and-error strategy. Her account suggests that clinicians in general practice are often faced with uncertainty about the diagnosis. In face of such uncertainties, clinicians may resort to testing the effectiveness of various treatments that could in turn inform them about the diagnosis.

#### **5.5.1.6 Dealing with uncertainty**

As shown above, diagnostic uncertainty is a characteristic feature of primary care practice and can be a challenging task for clinicians.

*“... you do get patients coming in with **things that you have never seen, you never heard of before**” (p#16)*

*Researcher: “And when you see a case that you have never seen before, how do you approach that?”*

*Doctor: “Umm, I think it is **important to be inquisitive**, I think it is important to **have an open mind**...using your consultation skills that you have learned and trying to ask nice, open-end questions to **allow the patient to talk**” (p#16)*

*“... patients who come in with **multiple different problems**...obviously **the diagnostic reasoning** and sort of the lead up to it is **challenging** from that point of view. It’s usually **complex patients with multiple problems** that makes you question whether there is more than one thing going on, whether you can umbrella term them into one diagnosis, that’s the difficult part.” (p#16)*

Uncertainty in primary care partly stems from the element of unpredictability of the patient group. As the participants describe here, the clinicians can be faced with illnesses that they have no familiarity with. In those cases, being open minded and inquisitive is important according to the participant. Another challenge is when patients present with multiple problems. Such complex cases involving co-morbidities can also be diagnostically challenging for junior doctors.

*“... I think it was a **very stunted history** I felt at the start, maybe I should have asked him more questions. It was [...] because he kept using terms like ‘I have got fluid in my ear’ or he felt like he had water in his ear, then he used the olive oil, went away, and now he was okay, and then he has suddenly woken up and he has blood on his pillow. But he doesn’t have any pains or anything like that. And then **Dr [supervisor’s name] comes in** and she is like ‘have you been using a cotton bud’ and he is like ‘yeah’. I think yeah, I think **he had sort of said that to me, but I didn’t think that I have registered it.**” (p#15)*

Above one of the participants was consulting a patient with a vague history and unfamiliar condition, which resulted in a stunted history. She did not have a clear sense of direction with the history and was not sure which pieces of information are most relevant for the diagnosis. Incomplete history in turn makes the diagnostic process challenging. Her strategy to resolve this was to turn to her supervisor, who offered a fresh perspective on the case and immediately directed the junior doctor towards the key information in the history. The participant admits that she did not pay adequate attention to that piece of information while taking history.

*“... I didn’t think it was anything serious, it’s just when you are not sure **I always get Dr [supervisor’s name] to look.**” (p#15)*

*“... So, I should have told him to come back, I didn’t, I asked to speak to one of the other GPs, because obviously **we review all the patients** who enter the clinic **just to make sure we have not missed anything**, and the advice was to call him back for another blood test in a week after changing the dose of his blood pressure tablets, so **I phoned him up and he was fine with that, he understood.**” (p#16)*

Turning to the supervisors for a second opinion was one of the main strategies to deal with diagnostic uncertainty in general practice. Both participants confirmed that they revise all cases with more experienced colleagues in the practice, even the less serious cases, in order to ensure safe practice. When the supervisor pointed out a mistake in the management plan for one of the patients, the participant immediately followed-up the patient with the necessary modifications of their care plan. The supervisor’s correction of the participant’s mistake did not seem to trigger any negative emotions, such as a sense of failure or incompetence, which suggests a supportive, positive learning environment.

*“... sometimes the GPs don’t know what is going on, and then really what they do is just **ask them to come back...**and that’s what **I quite like in primary care to just ask them to come back.**” (p#15)*

*Doctor to patient: "...if things change in the meantime, or you notice that it was becoming hoarse or, anything, **come back** and see us straight away just in case we need to have another think about things" (p#16)*

Another strategy to deal with uncertainty was the use of safety netting tactics. Asking the patient to come back in case their condition does not improve or gets worse was an essential part of the observed primary care consultations. One of the participants stresses the importance of safety netting due to the level of uncertainty in primary care practice. Having the opportunity to routinely use safety netting seemed to be reassuring for one of the participants, and perhaps counterbalances the inherent uncertainty.

*Researcher: "So your diagnosis was that she has got a virus?"*

*Doctor: "Yeah, that **she has got a viral upper respiratory chest infection.**"*

*Researcher: "And that she has another infection on top of that?"*

*Doctor: "That's the thing that you always worry that when someone gets a virus, especially when she was short of breath, to make sure that she is not getting a bacterial infection, because she is so rundown. **But I didn't really think so, but because she had that feeling of shorts of breath, just wanted to make sure that I covered her.**" (p#15)*

Finally, another strategy to deal with uncertainty was to choose a management option that is suited for the possibility of the more serious differential in mind. Here, the participant was faced with a symptom that could have been understood as an indication for one cause, while the rest of the history suggested a different cause. The participant decided to deal with this contradiction by treating the more serious differential which for her was perceived as the safer option.

#### **5.5.1.7 Management over diagnosis**

Another theme that emerged from the data was that coming up with a management plan for the patients is given more importance than knowing the exact diagnosis in primary care.

*"... Yeah, I think quite a lot of the time, **when you are a medical student, you are always focused on what the diagnosis is, but when you get into practice it is really not what's important.** I think you just need to be able to do your part." (p#15)*

One participant pointed out that there is a distinction between the diagnostic approach of medical students and junior doctor: while medical students tend to be focused heavily on trying to identify a diagnosis, junior doctors realize that the most important part of the consultation is to come up with a management plan, even in the absence of a

diagnosis. Her comment suggest that she perceives triaging as one of her main roles in primary care by ensuring referrals to more specialised care when necessary.

*“... sometimes the GPs don’t know what is going on, and then really what they do is just ask them to come back, so just saying you know ‘we try that, if it doesn’t work, come back’ and then I always hear people complain like, my friend has seen a doctor and it just seems like trial and error, and I was like ‘well, yeah, that’s what it is’. And yet people think like that GPs know everything, and really they are just, they are just triaging, yeah” (p#15)*

*“... I think, we don’t always make a diagnosis, like most times I don’t make a diagnosis, it’s more just about knowing where to go next, I had the lady with the bleeding and changed bowel habit and you just know that’s the two-week-rule and that, I don’t think, I think in that case I don’t really know what is going on, but you just know where you have got to refer to.” (p#15)*

One participant explained that a diagnosis is often not reached at primary care level even after exhausting all diagnostic resources. Her perception is that people sometimes have unrealistic expectations of the diagnostic process in primary care. According to her experience, people often expect certainty in primary care and can express dissatisfaction when those expectations are challenged. She is aware that primary care professionals are often faced with uncertainty during the diagnostic process, and it is more common not to make a diagnosis, but resort to ‘trial and error’ approach or refer patients to further investigations or specialist care.

*“...And it doesn’t really matter what the diagnosis is, because usually the management is the same for a lot of things.” (p#15)*

*“... Yeah. Like back pain, knee pain, leg pain, and it’s all the same thing, it’s just, we have to wait until it’s been going on for six weeks, then refer them to physiotherapy. And that usually does help.” (p#15)*

She also pointed out that many conditions are treated the same way regardless of the exact diagnosis. This apparent uncertainty about what exactly is wrong with the patient does not seem to bother her as long as she knows where to refer them next. In the examples above, various syndromes are grouped together under the same category that require the same management. In these cases, knowing the exact diagnosis is not the priority, the emphasis is on the management.

### 5.5.1.8 *The role of experience*

Previous experience influenced the way participants approached various diagnostic problems. The lack of relevant experience tended to hinder the diagnostic process as it made it difficult for participants to identify the key diagnostic information from the history. Having the opportunity to gain clinical experience was seen as one of the most helpful factors to aid their diagnostic skills. While having relevant clinical experience can aid the diagnostic process, at times high level of perceived familiarity with the condition can also lead to a more superficial use of physical examinations.

*“...It was really difficult actually, because I just, I didn’t really know why he had blood in his ear if I am honest which is why I did ask Dr [Supervisor’s name] to look... I think it was that I haven’t really seen many trauma ears, you know with people like sticking things in, I have seen quite a few infected ears, but not this.” (p#15)*

*Researcher: “...she [Supervisor] came over, and then she looked into his ears again and then she said it was probably trauma.”*

*Doctor: “Trauma. And it totally makes sense, because I did notice that the other ear was red as well which means that would make sense that he just putting cotton buds in there.” (p#15)*

Lack of experience with a particular condition can make the consultation challenging even during the Foundation years. The abstract above illustrated when participant found the diagnostic process very challenging as she was faced with a case she had no previous experience with. She failed to recognize the key information in the patient history which prevented her from reaching a diagnosis. To address her difficulties, she turned to her supervisor, who immediately drew her attention to the significant piece of information in the history. The supervisor’s guidance gave salience to information that has been ignored before, made her re-interpreting the signs and symptoms, and understand the diagnosis. This demonstrates that having the lack of experience makes it difficult focus on the relevant pieces of information which in turn hinders diagnosis.

*Researcher: “So what was it that helped you?”*

*Doctor: “So it’s the experience, just seeing the amount of patients I have seen, being allowed to be on your own a little bit, and being allowed to take a chance, obviously not taking any risks with patients, but being allowed to sort of head your money on something and then saying ‘right, this is the most plausible thing going on, let’s try this management first’, and it’s just a lot of supervisors are very encouraging, very open, and allowing me to do that and I think that is the one thing that helped me a lot through my training.” (p#16)*

The participant explains that besides seeing many patients, it was the opportunity to be allowed to take responsibility and practice the leading role in the consultation that was most helpful in developing his management skills. There is emphasis on the active feature of the learning, that actual doing and not merely observing, which is seen as the key in developing management skills. At the same time, he acknowledges the importance of patient safety while they are learning to manage patients.

*“...Again, **with problems that are straight forward**, I like to think that **I have got good management skills**, and certainly I have done a lot of placements in the past that were all very acute hospital medicine type **placements** where I was **often managing patients who were a lot more unwell** than the patients that I see in come in to general practice. So, you know, I did A&E placement where you have got patients who are dying in front of you, and you have got, I have done a surgical placement where I have had to manage really acutely unwell surgical patients a lot of time on my own, so I feel my managements this year certainly has become quite good, obviously there is a lot more things that you can learn, a lot more things to see, but I think **I am much more comfortable managing patients now than when I was in F1**, and certainly when I was a medical student when you are a bit like a rabbit in the headlights, you are not really sure what you are doing. (p#16)*

Experience with managing patients during their clinical placements helped improve the management skills of the participant. Managing acutely unwell patients in hospital settings increased his sense of competence in dealing with patients who present with less serious conditions in primary care. Towards the end of his Foundation training he felt confident in managing patients with straightforward problems and he felt more confident than he did at the beginning of his postgraduate training. He also pointed out that his management skills were much weaker as a medical student and he felt like a “*rabbit in the headlights*”. This suggests that as a medical student, he didn’t feel competent in management.

*Doctor: “He worried about having renal colic.”*

*Researcher: “Do you think there was any risk of that?”*

*Doctor: “No, **I have seen people with renal colic** and then they are in excruciating amount of pain, and he is just not, and he says it’s worth when lifting, when you get renal colic you just sore there all the time.” (p#15)*

*“...because I am a junior, I think the **other GPs** probably feel a bit more, because they have got **more experience** they probably **know when someone is not unwell**.” (p#15)*

Having previous clinical experience relevant to the consultation could influence their diagnostic approach in various ways. In the first extract the participant was relying on

previous experience of symptom presentation as a diagnostic tool to rule out a differential. In the second quotation, the participant explained how experience can help clinical judgement. She feels that experienced general practitioners are better at judging the seriousness of a patient's clinical presentation than junior doctors.

*Researcher: "Did you have a look at his leg"?*

*Doctor: "No I didn't. If I am honest, **a rash is a rash**. And I knew it was getting better. But yeah, **if I was a student, I probably would have looked at it**. I think **we just become a bit complacent**." (p#15)*

*"... So I checked her pulse, her SATS, umm what else did I check, I listened to her chest, and did her temperature, **should have done a blood pressure, but I didn't, but I expect it would have been fine**, she is not fainting or anything." (p#16)*

Even though experience is necessary for developing clinical competence, at times having a lot of experience with certain conditions could also have a negative effect on the diagnostic process. The extracts above show the participant's reaction when dealing with the most common patient complaints. The participants seem to be less thorough with her examinations relating to common symptoms. She admits that as a junior doctor she is becoming more "*complacent*" with her examinations while as medical students they would make sure to do all checks. Her use of the word complacent suggests both a sense of confidence and awareness that it may not be the best route.

### **5.5.2 Strong consultation skills**

Both participants emphasized the importance of allowing space for the patients to freely talk about their problems. They explored patients' concerns and understanding of their problems in order to guide the consultation and achieve mutual understanding.

Participants also relied on the use of online resources to confirm their diagnosis and to help communicate that diagnosis to the patients.

#### **5.5.2.1 Using open-ended questions and active listening**

Both participants emphasized the value of using open-ended questions throughout the consultations.

*"...you need to allow the **golden minute**, it's when patients come in and you ask a general open question, so 'Hello, how can I help?' or 'What can we do today?' and then you **let the patient talk for the first minute**, and often **all the important bits of the history come out in the first minute**, so you get the general idea of where you need to go with the history, and **then you can ask more narrowing, more focused questions**." (p#16)*

*“... I didn't want to get to too many closed questions too quickly, because I think already when he started like he has got pain when lifting something and it's worse when he is moving, like pretty much you are already there [knowing the diagnosis], but you kind of have to **give him the chance to tell you everything**, because I feel like if they don't get the chance to say everything they need to they haven't really been to the doctors, no one **properly listened**.”*  
( p#15 )

According to their accounts, asking open-ended questions and letting the patient talk at the beginning of the consultation have both diagnostic and psychological functions. In the first extract the doctor is explaining how starting the consultation with an open-ended question allows patients to disclose key information. In the second extract the doctor is talking about the psychological effect of letting the patient talk. This reflects her patient-centred approach and that for her making a diagnosis is not always the sole purpose of a primary care consultation. She acknowledged that being listened to can benefit the patient and that listening is important even when the patient is disclosing information that is not necessarily diagnostically relevant or when the clinician has already made up her mind about the diagnosis.

*“... I think **it is useful to know where they are**, because if they are like here, and you are going at something like, so **if he said something like 'oh I think it is cancer'** or **'I think I have a spinal cord injury'** then you would be like, okay, **I need to get him down** to here, whereas if he says **'oh I think it is just a muscle injury'** then you would be like **'yeah actually I kind of feel the same'**. I think if you don't know where they are, it is really difficult to like scope how much time you will need to spend doing it, yeah.”* (p#15)

*“... So I think it's just, with sciatica, **I always make sure I explain fully** and I explain that why we don't scan and why we just give like analgesia, because it doesn't affect any management, so it's really important, **people always have big expectations** about their back pain.”* (p#15)

*“... looking back at it, he has heard it, he understood I think, and then he is now trying to find his own solutions, so then now he is saying **'oh I have got my brother also said, how about stronger antihistamine'**, and I think he is now, **he almost had to adjust his own thinking process, trying to bring him to my level of thinking, or my level of understanding of what needs to actually be done.**”*  
( p#16 )

During the consultations, participants spent time exploring their patients' ideas, concerns and expectations relating to their problems. The participants explained that probing the patient's understanding of their own problem is important. They point out that exploring the patient's ideas can help the clinician understand how to approach the diagnostic conversation with the patient. They recognized the importance of achieving a

mutual understanding with the patient about the diagnosis as well as about choosing the most suitable management option. They explain that when patients have pre-determined ideas regarding the management they need, it is the clinician's role to explain the reasoning process for choosing or not choosing certain management options. By verbalizing the reasoning process behind their management plan, they make the consultation more transparent for the patient which can help addressing the patient's worries.

### 5.5.2.2 Using online resources

Using online resources was a central part of the observed primary care consultations.

*“... I used GP notebook, and I used DermNZ which is the dermatology website which has every single sort of dermatological problem in the world, and it will **show you photos** of what it might look like, and **what treatment it recommends**, and a lot of photos matched what his hands looked like.” (p#16)*

One participant was using online resources specialized for primary care practice in order to help him with the classification and identification of problems and symptoms during the consultations. Having access to these resources helps the clinician to diagnose illnesses where diagnosis relies on visual symptoms.

*Researcher: “So you looked it up during the consultation?”*

*Doctor: “Yeah, yeah, yeah, yes, so I think, I think, you know, **you are not in an exam**, you are not relying on everything, and sometimes you do forget things, and **you are still training**, and I think it is **important to check**, certainly I have done that in all of my placements, **when I have not been sure of something**, or I just wanted to look up something, or look up a dose or you know, it's **making sure that you are safe**, I think that's making sure that you're more happy with your diagnosis, and certainly his hands looked exactly like what a hands dermatitis looked like on the dermatology website.” (p#16)*

Having access to online resources during real consultations makes it different from exam scenarios where the examinee has to rely on their memory. The participant acknowledges the limitations of his own medical knowledge and explains that accessing online information promotes safe practice by counterbalancing their knowledge gaps. By allowing access to medical information, the use of websites can reduce the cognitive load in the consultation which means more cognitive resources remain for dealing with other parts of the consultation such as coming up with the most suitable management plans.

*Doctor: “I have **readily available resources**, and I tend to open them up all before my consultation starts, and it's also quite nice for the patients sometimes,*

*sometimes when you try to tell them a diagnosis then the patient doesn't want to hear it, or they are like 'oh no, I think it's something else', you often show them a photo, and say 'this is what it looks like' and they go 'oh it does look a bit like that' and you go, and it's often a bit more reassuring, because then you can say 'well, this is what it looks like' and you tell them 'don't read this, don't read Wikipedia, just read here, here is an information leaflet from [Patient.co.uk](http://Patient.co.uk) or from you know, DermNZ, go away and read it, and you'll understand more about your diagnosis'. So you, again, it goes back to patient education, actually getting a patient to accept the diagnosis, even if it's something they don't want to hear, it's getting them to accept it, and for him it's not a serious diagnosis, it's very common, but it's to understand, yeah."*

*Researcher: "So it's useful to have those [websites]?"*

*Doctor: "Very useful. Very very useful, yeah yeah, I think it makes, it makes my workload easier for sure and I think you know, any, in sort of the age of internet and computers I think, if you have got the resources use it, why not." (p#16)*

Another benefit of using informative websites during consultations is that they can help patients accept and come to terms with their diagnosis. The websites act as additional aid in both convincing and reassuring the patients. Websites can also assist as evidence for the clinician's diagnosis and demonstrate for the patient that the clinician's diagnosis is correct. The participant stressed the importance of discouraging the use of general search engines such as Wikipedia for patients in favour of more reliable online resources. Furthermore, he claims making use of these information technology resources reduces his workload.

*Doctor: "...So it's sort of showing the patient that I have not just made this up, this is what I think is going on and this is a very real physical symptom that accounts for how you are feeling psychologically. And she obviously responded, she was going like 'oh yeah, that is exactly how I am feeling' I think she is again realizing that this is more and more to do with her anxiety than anything else" Researcher: "Do you find that it is helpful to show them?"*

*Doctor: "Yeah, very helpful, honestly it is the most helpful thing you can do... I think some patients just need a bit more reassurance than others..." (p#16)*

*"... it becomes a bit more real when it's not just you're saying it, but the computer with all the world of information is saying it to them as well." (p#16)*

Using medical websites can act as a validation that the clinician's diagnosis is real and valid. The website seems to take on the role of an impartial 'third person' in the consultation and can reassure patients while also aiding patient education by providing visual representation of their problems.

*"...Um, I know, I missed, he said initially 158, but then I had to ask him again, because I wrote down 150, and that is probably because I am focused on the computer a little bit too much there to be honest. And again, that's because I*

*have got my own pre-conceived thing that I want to write on the computer or what I want to demonstrate that I have done in the past.” (p#16)*

Although using a computer can facilitate various aspects of the consultation, focusing on the computer screen too much may result in missing information from the patient’s history. This highlights the importance of teaching medical students the balance of using online resources during primary care consultations.

### **5.5.3 Patient-doctor dynamics**

The participants’ perceptions on patient and doctor relationships resembled a dynamic power-play. There were three side of the dynamics that appeared in the consultations: (1) rapport building and empowering patients; (2) shared decision making; (3) and finally the doctor can appear as a subordinate figure in the consultations, when they are afraid to upset or frustrate patients, or when they are consciously trying to prevent being blamed for possible diagnostic errors.

#### **5.5.3.1 Rapport building and empowering**

The first element of the doctor-patient dynamics was the doctor building rapport with the patient in order to facilitate the consultations.

*“...it’s patients coming in and **once they begin to trust you**, once they begin to **see that you kind of know what you are talking about**, they start **throwing other bits and pieces at you** to see how you respond to that and that’s I think what he is doing.” (p#16)*

One participant explained how demonstrating clinical competent can help building rapport with the patients, which in turn encourages patients to disclose more information about their problems.

*“... I think **I am trying to encourage him**, telling him that he is actually going in the right direction, because he is a very anxious guy” (p#16)*

*“... So I tend to have to tell him to take deep breaths in and out, try to close his eyes, try to relax, I try to avoid telling him the reading unless it’s a very good reading, and then I say ‘that’s excellent, keep going, we’ll do it one more time’, and it is **trying to encourage the patient to actually calm down a little bit**, because often blood pressure is driven by us, more than anything else.” (p#16)*

Providing encouragement and reassurance for the patient can not only help rapport building, but it can also facilitate the diagnostic process by obtaining more reliable

physical examination results. In the above examples, the participant was continuously reassuring the patient during the physical examinations in order to make sure that the patient remained calm. The doctor acknowledged the personality traits of the patient (i.e. “*anxious guy*”) and tailored his consultation style accordingly.

*“...As much as it is good to have continuity with one patient, and for one patient to see the same doctor again and again, **you don’t want to develop a reliance at the same time...**I had patients like that in the past that come in with a lot of mental health problems, **who you see three, four times, they sort of develop a reliance on you**, and actually you have to then say I will see you now in six weeks’ time rather than next week. And you have to sort of, he has to sort of **begin to take charge of your own health** a little bit as well.” (p#16)*

*“...Yes, so that’s from ‘Time To Talk’, which is a counselling, **self-referral type program**, and also I don’t refer patients directly, especially if the patient is very understanding and they are educated and they seem to know what they are doing, I tend to put the onus on them to do it, because it will be **more effective if they self-refer**, because then that’s their way of **admitting to themselves that there is something going on and I need more help**, rather than me saying, I am going to refer you and then they are going ‘oh, the doctor is referring me’, so let them do it rather than us.” (p#16)*

While building rapport with patients is an important part of the consultations, the participant acknowledged that patients can develop an undue reliance on their clinician. Empowering the patients and encouraging them to take initiative and control over their own healthcare regime may help to counteract the reliance that can develop after repeated consultations with the same clinician. Taking ownership of their problem can also be helpful in the management of certain mental health related conditions.

#### **5.5.3.2 Shared decision making and negotiations**

It has been clear from the consultations that the doctor is not perceived as an unquestionable authority figure. The consultations are interactive and involve frequent negotiations between the doctor and the patient.

*“...it became a bit of a generational thing actually, **a lot of patients now come in knowing what they want, with an agenda**, knowing exactly what diagnosis they think they have, um, and to be honest, you have to take that into account” (p#16)*

*“...it’s **only patients who are in their 90s that come in and go ‘you are the doctor, you tell me what you think is wrong’**, and if you tell them, whatever you say is gospel, you know, and nowadays it’s not the case, **nowadays patients come in with fixed ideas of what they think is going on...she came in saying ‘I have a chest infection’**, that’s what in her first consultation she was saying, I say ‘okay, what makes you think you have a chest infection?’, and then you take*

*her through the whole history and **actually there is nothing in the history that says she has got a chest infection**, nothing that I have found on examination, so went 'right, I don't think it is a chest infection' so and then they go 'oh, okay', **they go away, they think about the next thing, they come back,**' could it be this?', 'could it be that?', and it's a never ending cycle until you get to the bottom of it and then you're happy, both you and the patient are happy." (p#16)*

*"... Yes, so when patients come in, in generally when they, as they were excellent **patients they have done a lot of reading about it**, because all information is on Wikipedia, and easily accessible, they often read things and they think they are available to them ... so **it becomes a bit of an added layer to go 'right, now I need to discuss this**, and now **I need to explain why you can't have this'**, and you almost have to go a bit negative in the consultation which is not what patients want to hear, but it is often what you need to do to try and bring patients back to what you actually, what is realistic and what you can do.... It's **something that you see more and more in general practice unfortunately.**" (p#16)*

The participant explained that only elderly patients perceive doctors as indisputable experts with unquestionable knowledge nowadays. Most of the patients they are seeing today come in equipped with some knowledge or opinion about their own symptoms, diagnosis and management. They often have fixed ideas about what is wrong with them and how it should be addressed. Therefore, consultations are spent negotiating these views and the clinician has an added responsibility to explain and justify their clinical decisions.

*"... So a lot of it is **trying to convince the patient that we are doing the right thing for them**, but also allowing the patients sort of a bit of space to sort of process it themselves." (p#16)*

*"...So yeah, it's another complexity actually in general practice that **you have to then sell the product**, you have to then tell them exactly why you are giving them that and how to use it and rational for trying it again, so I think that's, I think that was his problem." (p#16)*

*"... Yeah, so your opinion has to be backed up by facts I think, and I think you know it's all very well to have an opinion, but **if the patient doesn't believe your opinion, they are not going to respond**, so you need to convince them that your opinion is correct." (p#16)*

The participant also felt that in primary care a lot of time is spent trying to convince patients that the doctors have their best interest at heart. Instead of accepting doctors' advice without hesitation, patients now question doctors' intentions and actions, which further complicates that patient-doctor dynamics. He also emphasized that patients are more likely to respond to treatments when they believe their clinician. This suggests

that building trust and rapport with the patients is important in order to achieve better management outcomes.

*Researcher: “Do you generally give the patients options of treatments or do you choose them the best one?”*

*Doctor: “You, so you’ve got, I think you have got the ‘patient hat’ and you’ve got the ‘clinician hat’ I think you have got, you know, you have got your own idea, what you ideally want to give, and then the patient might come in and say, actually, no, I don’t want that medication, I don’t want that at all, and you have to have a rethink. So I think a lot of it is, especially in this country, **a lot of it is negotiating with the patient what treatment they want to do**, and that’s certainly the drive that we had when I was training in medical school, it’s very much, **you need to be patient centred in your approach, you need to work with the patient rather than you are doctor, that’s patient, you have to listen, you very much work together, trying to get a diagnosis and a solution for their problem.**” (p#16)*

The participant acknowledged the importance of actively engaging patients in the selection of management plans. He explains that choosing a management plan is not entirely dependent on the clinician, as patients may prefer a different management option and in order to comply with patient centred approach clinicians need to work together with the patients.

### **5.5.3.3 Avoiding blame and frustrating patients**

As accountability for diagnostic mistakes is on the rise, another side of the patient-doctor dynamics was doctors trying to avoid blame from the patients in case something goes wrong in the diagnostic process.

*“... I think if I have seen his eardrum and it looked fine and wasn’t any sign of perforation, I would have been like ‘okay, I just leave it like this’, you know, but because I couldn’t see it, that’s why I wanted Dr [Supervisor’s name] to come in. Because actually when you think of your hearing, you can’t really take any risks. And I think **patients would have particularly blamed you later** if you didn’t warn them, that if they [...] they could have lost their hearing” (p#15)*

*“... you do [safety net] **all the time now**, because **you just don’t know who is going to turn around and say ‘well, you didn’t tell me that’.**” (p#15)*

When asking for second opinion from the supervisor, the aim is not only to address uncertainty and minimize risks for the patients, but also to protect themselves against adverse patient reaction in case of fault in the diagnosis and management. The participant describes an increasing emphasis on safety netting due to the heightened chance that patients will call them out for their mistakes.

*“...And I think any patient would be the same, you know **if they have to see the same person again and again and again they would become a bit frustrated.**” (p#16)*

*Researcher: “**Why do you think he is frustrated?**”*

*Doctor: “**He has had three or four different blood tests, he has had, you know, I have seen him, other doctors have seen him, he had a million more different investigations**”*

*Researcher: “**All trying to find out what’s wrong?**”*

*Doctor: “**All trying to find out why his blood pressure is higher and actually we might have been over investigating him**” (p#16)*

Finally, one participant described that even after developing a trusting relationship with a patient, having to repeatedly see the same doctor about the same problem may frustrate the patient which can compromise the patient’s trust in the doctor. Having a series of diagnostic tests done without arriving at a clear diagnosis can lead to negative reaction from the patient. The participant explained that he would try to counteract this frustration by allowing time for the patient to come to terms with the situation and to keep reassuring the patient that their health is the doctor’s main priority.

#### **5.5.3.4 GP role**

It was apparent that the participants are developing a strong sense of what the role of general practitioners is in the healthcare system.

*“... **it’s a different kettle of fish compared to every other speciality, just because you do get patients coming in with things that you have never seen, you never heard of before, um and a lot of problems aren’t necessarily medical, they are social, they are very, you know, or problems that, you know, that you don’t know much about and it’s not because you don’t know much medicine or you don’t know how to handle a problem, it’s more sort of problems that you don’t encounter, so you know, problems with housing, or problems with legalities and writing letters for courts and all sorts of very, very different**” (p#16)*

*“...it’s **learning how to support people in a more social way, as well as in a medical way when required**” (p#16)*

One participant pointed out that the patient group in primary care has its unique characteristics. They involve patient problems that are rare and therefore unfamiliar for the clinician. There are also many patients who present with social problems that that require non-medical solution. The participant sees dealing with these types of problems and supporting the patient in a holistic way as part of the unique GP role.

*“... now he said ‘oh in the past I have been diagnosed with sinus problems’, and he*

*may very well have a sinus problem, he may very well have an actual allergic rhinitis and hay fever and sinusitis, they all sort of go hand in hand really, but **he's might not been explained that in the past**. So it's now added sort of, not a burden, but **added responsibility to me in this consultations** to then say right it could have been sinusitis, it could have been that in the past, and that actually they are linked, but it might not have been explained like that in the past” (p#16)*

*“... That's a **common problem** that I have picked up on **in general practice** that **patients just don't know how to use inhalers or nasal sprays**, don't know how to use them until you **teach them** how to use them, and they often think 'oh I've used it once, I felt absolutely rubbish after using it, thus I don't want to ever use it again' and then you actually say 'no you just have been using it wrong'.” (p#16)*

*Doctor: “... I think it's **so underestimated how important it is**, because even with things like asthma and inhaler techniques, it's patients who don't know how to use an inhaler will and eventually get unwell, they will become unwell and then they will go to the hospital, seen in the hospital, have to stay there for two or three days or whatever x, y and z reasons and then they say, 'oh yeah, the GP gave me this inhaler, it never worked', but actually they just never used it properly, not that it hasn't worked, just didn't use it properly, and then, so I think **health education in general is massive in general practice and it is really underestimated how important it is**, so I think that's a good example of that.”*  
*Researcher: “More important than in secondary care?”*

*Doctor: “I think so, because you are the GP, **they are the ones that see the patients regularly**, they are the ones that, yes the specialist will say 'stop this and that' but you are the ones that are going to council them how to use them properly. So yes, that's it really, it goes part to, goes to **prevent sort of secondary referrals** I guess.” (p#16)*

Educating patients is an added responsibility in primary care and a very important one as it can prevent unnecessary hospitalization. The participants mentioned educating patients about their diagnosis as well as giving practical advice about how to use their prescribed treatment, such as nose sprays and inhalers can be helpful for patients. One participant used the continuity of care model of primary care to explain the importance of their role in patient education.

## 5.6 PHASE 4 – SURVEY RESULTS

### 5.6.1 Descriptive analysis – Penultimate year medical students

#### 5.6.1.1 Open ended questions

##### AUTOMATIC ASSOCIATIONS WITH OSCEs

Students were asked what the first thing was that comes to mind when they think of OSCEs. From the responses, 8 themes emerged: *(1) stress and anxiety, (2) pressure, (3) clinical skills exam, (4) history taking, (5) artificiality, (6) time pressure, (7) subjectivity, and (8) preparation.*

The most common automatic association with OSCEs were stress and anxiety. Students perceived these exams as anxiety provoking and highly intense. Most students associated it with clinical skills examination, while others associated it with history taking. Some students mentioned the artificiality of the exam and how it involves acting and box-ticking as opposed to real consultations. For many students it was the time pressure of the OSCEs that first came to mind. There were students who associated it with subjectivity and unreliability. Finally, some students thought of the ample practice in preparation to OSCEs as the first thing that came to their mind.

##### PERCEIVED DIFFERENCE BETWEEN THE DIAGNOSTIC PROCESS IN PRIMARY AND SECONDARY CARE

Students were asked how they thought the diagnostic process in primary care was different from secondary care. From their answers, 9 themes emerged: *(1) broad range of conditions, (2) starting from scratch, (3) less severe and less complicated cases, (4) ruling out serious conditions and safeguarding, (5) time pressure, (6) quick history, slow diagnosis, (7) more reliant on signs and symptoms, less access to investigations, (8) less help and teamwork, (9) continuity of care.*

One of the main differences that students pointed out was that primary care involves a much broader range of conditions than secondary care. They thought primary care practitioners need to be more generalists and require a broad range of knowledge in order to be able to deal with the wider range of possible differentials in primary care. They also mentioned that primary care is usually the first point of contact for patients and therefore there is nothing yet known about the diagnosis, while in secondary care, the diagnostic process has already started and the list of potential differentials has been narrowed down. Therefore, when working in primary care, clinicians have to be open

mindful and consider a wide range of possibilities to initiate the diagnostic process. Students also pointed out that the first task in primary care is to decide whether the patient is actually ill or not, as patients presenting in primary care are often less severe and complicated than those in secondary care. Other important tasks in primary care involve ruling out serious conditions, triaging and safeguarding patients.

Many students highlighted the time pressure of the consultations as one of the main differences between the diagnostic process in primary and secondary care. Some students emphasized that they don't have enough time to think during the consultations, as the patients expect an answer there and then. The time pressure also means that the history taking needs to be quicker than in secondary care, while the diagnostic process itself tends to be slower in primary care. Tests and lab results take much longer to get back, which can slow down the diagnostic process. Having limited access to tests and investigations also means that primary care practitioners are more reliant on history, examinations and test of treatment as diagnostic tools. They also have less access to help from their colleagues and are more likely to diagnose and manage patients independently. On the other hand, in secondary care, there is access to tests, investigations, expert help and the diagnostic process is likely to be a team work.

Finally, students pointed out that primary care is a continuity of care, which means doctors often know the patients for a long time. They tend to know the previous medical history of the patients and also there is more opportunity for rapport building with the patients and their families.

#### MOST CHALLENGING PART OF THE DIAGNOSTIC PROCESS IN PRIMARY CARE

Finally, students were asked what they find most challenging about the diagnostic process in primary care. Their responses covered a wide range of potential difficulties, from which 10 main themes were identified: **(1) broad range of possible differentials, (2) ambiguous symptom presentation, (3) comorbidity and multiple problems, (4) knowing what is relevant, (5) narrowing down the list of differentials, (6) listening and thinking at the same time (7) time pressure, (8) limited access to tests, (9) lack of access to help, and (10) consultation skills.**

Students found the broad range of possible differentials that could present in primary care challenging. Some were worried that they wouldn't have the relevant knowledge to identify all the wide range of possible differentials. They also pointed out that symptom

presentation in primary care is often vague and highly variable, which makes the diagnostic process challenging. Furthermore, patients often have comorbid conditions, where it is difficult to work out which ones are acutely relevant. Also, patients often have multiple different problems that they want to be addressed during the consultation that medical students find challenging.

From all the information presented by the patient, students find it difficult to identify the most relevant information to focus on to direct the consultation. They also find it challenging to know that they have asked all the relevant questions necessary, and to narrow down the list of initial differentials and reach a definite diagnosis. Furthermore, students pointed out that they find it difficult to think about the diagnostic ideas and keep listening to the patient at the same time.

The time pressure of the consultations was also mentioned as one of the major challenges to the diagnostic process. They also emphasized limited access to diagnostic tests and limited access to help from their superiors as challenging features of primary care consultations. Finally, some students found consultation skills challenging, such as formulating the diagnosis in front of the patient, obtaining sufficient information from the patient, or breaking bad news.

#### ***5.6.1.2 Likert-scale data***

Participants were asked about their experiences in OSCEs, then their experiences during primary care consultations. Participants were asked to indicate how much each of a list of statements characterizes their approach during OSCEs. The answer to each of the questions was indicated on 6-point Likert scales of either always to never (i.e. always, often, sometimes, rarely, very rarely, or never), or strongly agree to strongly disagree (i.e. strongly agree, agree, slightly agree, slightly disagree, disagree, or strongly disagree).

#### OSCE VERSUS REAL LIFE

62% of students agreed to same extent that their thinking process during the OSCEs resembles their thinking process during real clinical situations, which suggests that the majority of the participants perceived OSCEs as eliciting cognitions similar to those in real clinical situations. However, the findings about their corresponding behaviour were somewhat more conflicting. On one hand, 75% of students also agreed to some extent

that they ask the same questions during real consultations that they would during a similar OSCE station. On the other hand, when asked whether they would ask questions during OSCE stations that they would not ask in real situations, 73% admitted that it would happen sometimes. Also, when asked whether they would ask questions that they thought were on the assessment checklist, even if they considered those questions diagnostically irrelevant, 56% said they would often or always do so. This indicates that while the majority of penultimate year students perceive their cognitions to be similar during OSCEs and real consultations, when asked about the corresponding verbal behaviour [i.e. asking the questions], half of the students admit asking questions even when they consider them irrelevant or when they wouldn't ask those questions in real life. This indicates that ***while OSCEs can elicit realistic diagnostic cognitions, the verbalized behaviour does not always correspond with those cognitions.***

#### PRETENDED COMPETENCE

56% of students agreed that they did not want to leave moments of silence during OSCEs, because that makes it look like they don't know what they are doing. 32% of participants admitted that sometimes they keep asking questions to pretend that they know what they are doing. 28% said they often or always use this strategy to pretend competence. 36% said that sometimes they pretend that they understand what is going on, even when they do not. 29% said they often or always engage in such behaviour. This suggests a ***high level of pretended competence and that students actively engage in behaviours that can disguise their weaknesses during OSCEs.*** In primary care consultations, only 37% of students agreed that they do not want to leave moments of silence, because that makes it look like they don't know what they are doing. 47% said they sometimes pretend that they understand what is going on, even when they do not, while only 13% said they behave this way often or always. More importantly, 89% of the participants said they would admit when they don't understand something during real consultations, which is essential for safe practicing.

#### FOCUSING ON THE ASSESSMENT CHECKLIST

88% of participants agreed that during OSCEs they ask questions to tick boxes on the examination checklist. This shows that the majority of students are focusing on achieving a high score on their examination checklists while completing OSCE stations. 45% indicated that they regularly try to guess what is on the examination checklist while completing a station. This implies that ***their attention would be divided between the consultation itself and the checklist.***

### STRUCTURED APPROACH

86% of students agreed that they go through the same structured history each time during OSCE consultations. 85% of students also agreed that they tend to go through the same structured history during real primary care consultations as well. 85% of students also indicated that they often or always use mnemonic devices during history taking in OSCEs. 82% often or always uses mnemonic devices during real consultations as well. This shows that students at this point in their training are very much ***relying on frameworks and mnemonics during both real and simulated consultations.***

### THINKING, LISTENING AND TALKING

82% of students agreed that they find it difficult to think about the diagnosis and listen to the patient at the same time when they are in an OSCE setting. 36% of participants said they often or always miss parts of what the patient is saying because they are concentrating on what to ask next, 45% said it happens to them sometimes, and only 4% said it never happens to them. In contrast, 41% of students stated that they rarely to never have this problems in real clinical situations. This suggests that ***thinking of the next questions distracts students more and interferes with their listening skills when in an exam situation.***

### OSCE AND DIAGNOSTIC REASONING

When asked explicitly whether students find OSCEs a good opportunity for critical thinking, 82% of students agreed. When asked whether they think OSCEs test their diagnostic reasoning, 82% agreed. This is strong indication that ***students share the educators' view that OSCEs are used to assess diagnostic reasoning*** and critical thinking skills. However, these opinions are in sharp contrast with the participants' response to other questions that indirectly asked about their diagnostic reasoning during OSCEs.

### MEMORIZED CHECKLISTS

73% of participants agreed that OSCEs test the fact that I have memorized all the different stations. In line with this, 62% of students said that they often or always try to memorize station checklists as part of their OSCE preparations, and 8% said they sometimes try memorizing station checklists prior to OSCEs. This shows that ***the majority of penultimate year students treat the OSCEs to some extent as a***

*contextualized memory recall task*. This pattern of thinking is in contrast with the students' views about critical thinking and diagnostic reasoning during OSCEs.

#### TIME PRESSURE

53% of participants said they rarely, very rarely, or never have enough time to think through the problems critically during OSCE stations. None of the students said they always have time to think through the problems critically during the OSCEs. On the other hand, 44% of the students stated that they often or always have enough time to critically think through the problems during real primary care consultations. While only 22% of the students claimed that they rarely, very rarely or never have time to think through the problems critically in real primary care consultations. This suggests that *while the OSCE stations are too short for most students to think through the problems critically, the time frame for real consultations are more realistically adjusted to the diagnostic skills of penultimate year students*. However, for some students even time they are given during their primary care placements is insufficient to accommodate their diagnostic problem-solving skills.

### **5.6.2 Descriptive analysis – Final year medical students**

#### **5.6.2.1 Open-ended questions**

##### AUTOMATIC ASSOCIATIONS WITH OSCEs

When asked about the first word that came to mind when thinking of OSCEs, 9 main topics were mentioned: (1) *stress and anxiety*, (2) *pressure*, (3) *clinical skills exam*, (4) *time pressure*, (5) *communication skills*, (6) *structured exam*, (7) *artificiality*, (8) *box-ticking*, (9) *unfair*.

The most frequently mentioned word was stress. Many students associated OSCEs with stress, anxiety, fear, and panic. They thought of it as intense and difficult. They also often associated it with clinical and practical skills. Time pressure was also frequently mentioned. Some students associated it with communication skills, while others called it a structured exam. Some students pointed to the artificiality of the scenarios and associated it with acting and unrealistic scenarios. Finally, some students associated it to be unfair, subjective, or a box-ticking exercise. These automatic associations indicate a general negativity towards OSCEs.

PERCEIVED DIFFERENCE BETWEEN THE DIAGNOSTIC PROCESS IN PRIMARY AND SECONDARY CARE

When students were asked how they thought the diagnostic process in primary care was different from secondary care, 9 main themes were mentioned: *(1) broad range of conditions, (2) diagnosis starting from scratch, (3) less serious conditions, (4) test of time and treatment, (5) different diagnostic aim, (6) time pressure, (7) less thorough history and investigations, (8) limited access to test, and (9) limited access to support.*

Students pointed out that the patient group is different in primary and secondary care settings. In primary care, patients can present with a wide range of differentials, which also means that as a clinician, they need to consider a much broader scope of differentials than they would in secondary care. Also, as primary care is the first point of contact for patients, clinicians often have limited prior information and have to start the diagnostic process from the very beginning, while in secondary care, their diagnosis is already somewhat focused and narrowed down. Primary care patients also tend to be presenting with less severe, common illnesses, and clinicians are more willing to use test of time or test of treatment as part of their diagnostic process. Primary care is more concerned with ruling out serious conditions as opposed to setting up a definite diagnosis, as management is often possible without a diagnosis.

Many students pointed out that there is less time for consultations in primary care as opposed to secondary care. This makes the diagnostic task more difficult in primary care, as there is limited time for history and examinations. The time pressure also means that they cannot be as thorough in history taking and investigations as they would be in a secondary care setting.

Students mentioned that primary care setting is characterized by limited access to resources. They highlighted that there are much more limited in the scope of tests they can order to help their diagnostic process and tests take much longer than in secondary care setting. Due to these limitations, in primary care, they need to rely on the history, examinations and clinical judgement to guide the diagnostic process.

Finally, students also mentioned that there is more support and team working in secondary care, while they need to work on their own in primary care. Some viewed this as opportunity for more independence, while others as lack of support.

#### MOST CHALLENGING PART OF THE DIAGNOSTIC PROCESS IN PRIMARY CARE

When students were asked what they find most challenging about the diagnostic process in primary care, 8 main themes were mentioned: (1) ***broad domain of differentials***, (2) ***judging seriousness***, (3) ***narrowing down differentials***, (4) ***comorbidity and vague symptoms***, (5) ***lack of experience***, (6) ***time pressure***, (7) ***relying on history and examinations***, and (8) ***limited access to help***.

Students mentioned the broad range of symptom presentation in primary care as something they find challenging. Being first point of contact also means that they may see sub-threshold symptoms that are difficult to identify. The variety of possible differentials makes generating an initial list of differentials challenging for the students, as they want to make sure that they do not miss out any differentials that it may be.

Once they have a list of initial differentials, students find it difficult to narrow down that broad list and decide on a single diagnosis. They find it challenging to rule out serious conditions and decide whether the case justifies referral. They find that comorbidities, atypical or vague symptom presentations make the diagnostic process even more difficult. They also commented that symptom presentations hardly ever match textbook descriptions, and patients often do not provide sufficient history, making the diagnostic process difficult in practice. Finally, not having previous knowledge or experience with certain conditions make the diagnostic process challenging.

The time constrain of primary care consultations was the challenge most frequently mentioned by students. Many have expressed that the 10-minute time constrain of consultations mean that they do not have sufficient time to think of differentials, to take thorough history, to order tests that could help their diagnosis, or deal with complicate cases. Having to rely on their history, physical examinations and clinical judgement while having limited access to tests and lab results to support their diagnostic process was also found challenging for the students. Finally, students mentioned being on their own and limited access to help from their superiors as a challenge.

#### ***5.6.2.2 Likert-scale data***

##### OCSE VERSUS REAL LIFE

When asked whether their thinking process during the OSCEs resembles their thinking process during real clinical situations, 62% of students agreed to some extent, which was the same percentage as observed in penultimate year students. However, 41% of

students didn't agree with the claim that they ask the same questions during real consultations that they would during a similar OSCE station, which was a significantly higher than in case of penultimate students. This suggests a change in perception, as more mature students perceive a greater discrepancy between their OSCE behaviour and their behaviour in real clinical settings. When asked whether they would ask questions they would not ask in a real situation, 58% said they would do it at least sometimes. When asked whether they would ask questions even if they consider it diagnostically irrelevant if they thought it was on the assessment checklist, 70% said they would often or always do so. This suggests that **diagnostic relevance is not the sole motive that guides their questioning during OSCEs, and they would readily ask questions they consider irrelevant if they thought they could get higher scores for those.**

#### PRETENDED COMPETENCE

54% of students agreed that they did not want to leave moments of silence during OSCEs, because that makes it look like they did not know what they are doing. 41% of students also agreed that they did not want to leave moments of silence, because that makes it look like they do not know what they are doing during primary care consultations. This shows that many students do not feel confident using moments of silence during the consultation – real or simulated – which could provide them opportunity to gather their thoughts. 38% of participants said that sometimes they keep asking questions to pretend that they know what they are doing during OSCEs, while 27% said they often or always use this strategy to pretend competence. 31% said that sometimes they pretend that they understand what is going on, even when they do not, while 44% said they often or always engage in such behaviour during OSCEs. This suggests a high level of pretended competence and that students actively engage in behaviours that can disguise their weaknesses during OSCEs. When the same questions were asked about real primary care setting, 37% said they sometimes pretend that they understand what is going on, even when they do not, while only 16% said they behave this way often or always. Also, 90% of the participants said they would admit when they don't understand something during real consultations. This suggests a **more open approach to admitting weaknesses during real consultations as opposed to exam scenarios.** The same trends were observed in penultimate year students, suggesting that there is no significant change in these perceptions over the last two years.

#### FOCUSING ON THE ASSESSMENT CHECKLIST

91% of participants agreed that during OSCEs they ask questions to tick boxes on the examination checklist. 51% also indicated that they regularly try to guess what is on the examination checklist while completing a station. These percentages were slightly, though not significantly higher than those found in penultimate year students. However, the increasing trend may indicate a **stronger focus on scoring higher on examination checklist as the students approach graduation.**

#### STRUCTURED APPROACH

83% of students agreed that they go through the same structured history each time during OSCE consultations. 77% of students also agreed that they tend to go through the same structured history during real primary care consultations as well. 76% of students also indicated that they often or always use mnemonic devices during history taking in OSCEs. 83% often or always uses mnemonic devices during real consultations as well. This suggests that data collection is an effortful and rule following. Most of these findings show a slight, although not significant decrease in comparison to penultimate year students. It shows that **the majority of students even in their final year frequently uses mnemonics and stick to common history structures during both real and simulated consultations.**

#### THINKING, LISTENING AND TALKING

68% of students agreed that they find it difficult to think about the diagnosis and listen to the patient at the same time when they are in an OSCE setting. This was a significant decrease from penultimate year which indicates an **improvement in their flexibility of thinking.** However, it also shows that the majority of final year students still find it difficult to think and listen at the same time during OSCE consultations. 33% of participants said they often or always miss parts of what the patient is saying because they are concentrating on what to ask next, 40% said it happens to them sometimes, and only 1% said it never happens to them. Similar pattern was found in penultimate year students. Although the perception of the difficulty balancing thinking and listening decreased between the year groups, the interference of missing information due to thinking of the next questions remained the same. In contrast, 48% of students stated that they rarely to never have problems in real clinical situations about thinking of the next questions interfering with their listening skills, which was similar to that found in the penultimate year group.

### OSCE AND DIAGNOSTIC REASONING

When asked whether students find OSCEs a good opportunity for critical thinking, 56% of students agreed. When asked whether they think OSCEs test their diagnostic reasoning, 79% agreed. This shows that **less final year students than penultimate students think that OSCEs can assess diagnostic reasoning and critical thinking skills**. However, still a large proportion of students associate OSCEs with critical thinking and diagnostic reasoning when asked directly.

### MEMORIZED CHECKLISTS

59% of participants agreed that OSCEs test the fact that I have memorized all the different stations. In line with this, 45% of students said that they often or always try to memorize station checklists as part of their OSCE preparations, and 21% of participants said they sometimes try memorizing station checklists prior to OSCEs. This indicates a slight decrease from penultimate year, but still indicates that **most students perceive OSCEs as memory tests**, which contradicts their views on OSCEs testing critical thinking and diagnostic reasoning.

### TIME PRESSURE

50% of participants said they rarely, very rarely, or never have enough time to think through the problems critically during OSCE stations. None of the students said they always have time to think through the problems critically during the OSCEs. On the other hand, 54% of the students stated that they often or always have enough time to critically think through the problems during real primary care consultations. Also 11% of the students claimed that they rarely to never have time to think through the problems critically. The same response patterns were found in penultimate year students. This suggests that **a large proportion of final year students find OSCE stations too time pressured**, while they are better able to think through problems in real clinical settings. However, for some students even the longer time they are allowed during their primary care placements is not sufficient for their diagnostic problem solving.

### 5.6.3 COMPARATIVE ANALYSIS of penultimate and final year students

The Wilcoxon-Mann-Whitney test revealed that there were **only two questions on which the two groups scored significantly differently** (See *Appendix K*), which were:

- 1) *'During OSCEs, I find it difficult to think about the diagnosis and listen to the patient at the same time'*
- 2) *'During primary care consultations, I ask all the questions that I would at an OSCE station with a similar case'*

The first question was intended to test the flexibility of thinking of participants. 82% of penultimate students found it difficult to think about the diagnosis and listen to the patient at the same time when they are in an OSCE setting (See *Table 9*). On the other hand, only 68% of final year students agreed with the same claim. This finding indicates that there seems to be a significant improvement from penultimate to final year in the students' skills to think and listen at the same time during OSCE consultations. However, it also means that despite the significant improvement, the majority of final year students still found it difficult to think and listen at the same time during OSCE consultations.

**Table 9:** *Students' perception of balancing thinking and listening during OSCE consultations*

f. I find it difficult to think about the diagnosis and listen to the patient at the same time	What year of the undergraduate program are you currently in?	
	Penultimate year	Final year
Strongly Agree	17.81%	9.76%
Agree	36.99%	23.17%
Slightly Agree	27.40%	35.37%
Slightly Disagree	10.96%	19.51%
Disagree	5.48%	10.98%
Strongly Disagree	1.37%	1.22%

There may be various explanations for this finding. It could indicate an improvement in students' skills to balance thinking and listening during diagnostic consultations. Alternatively, it could indicate that students are getting more adapted to the OSCE setting as they approach graduation, and thereby reducing the cognitive load from contextual pressures. The latter explanation is supported by the finding that there was no significant difference in the flexibility of thinking of penultimate and final year students when they were asked about their real primary care experiences. Also, when comparing students' responses to the statement "*I focus on what questions to ask next, so I miss parts of what the patient is saying*" in OSCE versus primary care settings, there was a significant difference using the Wilcoxon signed rank sum test ( $Z=-5.134$ ; Asymp. Sig. (2-tailed) = 0.000). The Wilcoxon signed rank sum test is a non-parametric test that can be used to compare related sample or repeated measurements within one sample without having to rely on the normal distribution criteria of the responses. This test revealed that during OSCEs, students find it significantly more difficult to think of what to ask next and listen to the patient at the same time than in a real clinical scenario. This finding was true for both penultimate and final year medical students. This suggests that students find it more difficult to balance thinking and listening in an assessment setting, than in real clinical scenarios.

The second statement, '*During primary care consultations, I ask all the questions that I would at an OSCE station with a similar case*' was designed to test students' perception of the similarity between OSCE stations and real clinical scenarios with regards to the questions they tend to ask. Penultimate year medical students were more likely to agree with this statement than final year students. 75% of penultimate year students agreed to some extent that they ask the same questions during real consultations that they would during a similar OSCE station (See *Table 10*). However, 41% of final year students didn't agree with the same claim, which was a significantly higher than in case of penultimate students. This suggests a change in perception, as more mature students perceive a greater discrepancy between the questions they ask during OSCE consultations and the questions they ask during real consultations.

**Table 10:** Students' perception of discrepancy between questions asked during OSCEs and real consultations

d. I ask all the questions that I would at an OSCE station with a similar case	What year of the undergraduate program are you currently in?	
	Penultimate year	Final year
Strongly Agree	6.85%	4.88%
Agree	38.36%	24.39%
Slightly Agree	30.14%	29.27%
Slightly Disagree	17.81%	25.61%
Disagree	4.11%	9.76%
Strongly Disagree	2.74%	6.10%

The difference between the distributions of responses to all the other items of the questionnaire did not reach significance level. This suggests that in many aspects, students' approach to OSCEs and primary care consultations do not significantly change during the last two years of their training. They demonstrated a high level of pretended competence during exams and they often ask questions that they wouldn't necessarily ask in real clinical scenarios. They tend to focus on the assessment checklist, which they often memorize prior to the exam, and they try to tick all the boxes that they think are on the evaluation checklist. They tend to structure all consultations the same way, and rely on the use of mnemonic devices. Finally, most of them find OSCEs too time pressured which does not allow them to think through the problem critically. However, even though these findings all point to OSCEs not promoting diagnostic reasoning, when asked directly, most students assumed that OSCEs do in fact assess diagnostic reasoning. Finally, students seem to have a different approach in real primary care scenarios, where they tend to admit when they are out of their depth, they had much less difficulties with balancing thinking and listening, and they have more time to think through the problems a hand.

### 6.1 INTRODUCTION

The final chapter begins with the discussion of the main findings. First, the findings about the diagnostic reasoning skills of senior medical students and Foundation trainees is outlined. There were several similarities and differences observed across the years from penultimate undergraduate to foundation years, which are explained here. These findings are contextualised in relation to existing theories and models of diagnostic reasoning. Then, the '*OSCE effect*' is discussed, a theoretical model based on the present study. It proposes a novel account on how fourth year medical students use their diagnostic skills during Objective Structured Clinical Examinations (OSCEs). In line with existing theories that emphasize the importance of contextual factors on cognition, the OSCE setting appears to significantly influence the cognitions and behaviours of senior medical students. The present findings also suggest that a checklist-style assessment of diagnostic skills based on observing these OSCE consultations may not be appropriate to evaluate cognitive skills.

Following the discussions of the main findings, the practical implications of the findings are presented. The main recommendations formulated in relation to curriculum design involve: (1) facilitating the students' transition from hospital to primary care setting, (2) facilitating the students' transition from history to diagnosis and management, (3) helping students develop a better clinical skills and sound core knowledge, (4) redesigning learning material to better promote diagnostic reasoning, and (5) designing simulated practice that facilitates the use of diagnostic reasoning. Following a discussion of curriculum design, the implications of the present findings with regards to the assessment of diagnostic reasoning skills are discussed, and further two recommendations outlined.

The practical implications are followed by a discussion on how the present findings could be integrated into the existing theoretical framework of clinical competency assessment in medical education in order to emphasize the importance of diagnostic reasoning skills.

Finally, the limitations of the present findings and direction for future research are explored, followed by the concluding remarks.

## 6.2 DISCUSSION OF THE FINDINGS

The present study has evaluated the diagnostic reasoning skills of undergraduate medical trainees approaching the graduation transition and newly graduate trainees working in primary care setting. While the OSCE nature of the consultations influenced the diagnostic approach of the fourth-year students in the present study, it was also possible to draw some general conclusions about the students' diagnostic reasoning skills in primary care settings. The distinction between students OSCE-style reasoning and their reasoning in real clinical scenarios was based on the students' interpretative accounts. Once the diagnostic reasoning skills of penultimate year students is outlined, the diagnostic skills of final year students and Foundation trainees will be discussed.

### 6.2.1 Diagnostic reasoning: from medical school to the real world

#### 6.2.1.1 Penultimate year students' diagnostic reasoning

The present study has revealed that the **primary care setting** can be a challenging environment for senior medical students from a diagnostic perspective. The findings show that penultimate year medical students' previous clinical experiences are often restricted to secondary care setting, where the diagnostic process is perceived to be significantly different from the one in primary care. According to the survey results, in secondary care students usually deal with more specialised problems, in which the diagnostic process has already been initiated and the differentials have been narrowed-down by the triaging team. They often deal with more severe problems, but at the same time, they have quick and easy access to diagnostic tests, and generally have longer time for history and diagnosis than in primary care. They are also used to the diagnostic process involving teamwork, whereby help and support is readily available from their colleagues. On the other hand, the primary care setting is significantly different. There, they have to deal with a broad range of conditions, and they are responsible for narrowing down the differentials and making the triaging decisions themselves. They have to deal with the time pressure of each consultation and they cannot rely on diagnostic test and investigations to help their diagnostic process. They are often faced with comorbidity and ambiguous symptom presentation. They also perceive the diagnostic process to be more independent, with little help or support from their colleagues. With respect to history taking in secondary care, students' priority tends to be to gather all available information from the patients. The primary care setting of the simulated consultations meant that **history taking needed to be quicker, more focused and inherently less thorough**. The reflective interviews showed that students seemed

to struggle at times to adapt to these circumstances. This is consistent with previous research findings, Williamson et al. (2013) also observed that medical students in their penultimate year of undergraduate education were more used to the traditional model of medicine that involves detailed history taking, examinations, and differential diagnosis, which does not necessarily work as effectively in a time-pressured primary care setting (Williamson et al., 2013).

The next challenge students faced, during the simulated consultations, was the **new responsibility of being in charge of the diagnostic process from start to finish.**

During the consultations they were not only expected to take a history from the simulated patients, but also to arrive at a diagnosis and decide on appropriate management for the patient. While students had much experience with history taking in the past, up to that point in their training they have not been given the responsibility of diagnosis and management before.

*“...I am still at the mode of like, you know, make sure you know your history and can take history properly and then the management is someone else is going to do that” (p#5)*

Therefore, **taking a history and deciding on the diagnosis and management were perceived as two separate, sequential stages of the consultation,** from which they only had to focus on the first one so far. This meant that their initial information gathering was often led by the priority of collecting information thoroughly, but without considering the diagnostic implications of the emerging information. This highlights the fact that senior medical students face an **important transition in their penultimate year** of undergraduate study: they are expected to make a move from being in charge of history taking to being in charge of diagnostic decisions. This **transition involves starting to link history with diagnostic ideas, to engage in diagnostic reasoning, and to arrive at decisions about management.** Taking on the decision-making responsibility for diagnosis and management was difficult for the students.

*“...we practice histories and I feel quite okay talking to somebody, and asking questions and talking about it and discussing it, but coming to a decision is difficult” (p#11)*

However, according to the learning theory of Dreyfus, exposure to this responsibility is necessary for them to advance to higher levels of expertise (Dreyfus, 2004). Practising the decision-making role could also help them prepare for their roles as junior doctors.

The students' diagnostic process began with identifying the presenting complaint based on either the station instructions on the door or based on the information revealed by the patient at the beginning of the consultation. Once it was identified, some students tried to immediately link the presenting complaint to the most likely corresponding system involved in an effort to narrow down the list of relevant differentials, while other students went **straight into hypothesis generation without further refinement** of the presenting complaint.

*“...you are trying to think about anything that it could be” (p#1)*

The potential problem with narrowing down differentials based on a system approach is that as students learn about various systems separately during their early years of training, when they tend to be unpractised with integrating system information, and therefore they are less likely to associate symptoms with other than the obvious system. However, chest pain cannot only indicate respiratory illness, it can mean stomach problems, and conversely, myocardial infarction may present without chest pain (Boshuizen et al., 2004). Only some of the participants in the present study showed a conscious attempt to integrate system information.

In most cases, students tried to **generate a list of differentials based on a single symptom** that was identified as the presenting complaint. Exploring the presenting complaint was often followed by generic information gathering, whereby standard questions were asked and a large amount of information was gathered without much further diagnostic interpretation. As students felt **obliged to cover all elements of the traditional history** structure in every consultation, they at times suspended their diagnostic reasoning while completing the traditional history taking.

*“...I was just going back to the structure, we've always been taught in terms of like things you need to remember, drug history, allergies, family history, and kind of the social history, so this bit doesn't feel as natural yet, because I think I kind of already knew what the problem was, so I was just doing that to tick boxes rather than to actually make it more the diagnosis I think” (p#6)*

Once they had collected all the information, they tended to engage in **exhaustive hypothesis testing** in an attempt to deal with the broad range of possible problems that may present in primary care. While an exhaustive hypothesis approach is often observed in the case of novice students, this type of reasoning process does not suit the time constraints of the primary care setting, nor does it demonstrate an optimal reasoning strategy. Exhaustive hypothesis testing approach involves collecting a large amount of information from the patients first, then generating the largest possible pool of differentials, followed by testing them all (Croskerry, 2002).

*“...I am worried about malignancy, so in my head I am thinking, what questions do I need to ask for cancer, so I am saying, so then I am working through a list yeah...And now I am working through a different list, I am working through a list again, but it’s a different list, so now I am working through a list of any kind of damage to the spinal cord, and kind of red flag from that point of view...Now I have got another list that I am thinking about, so now I am thinking about any kind of inflammatory, autoimmune disease...And that’s why I am asking about those. So then I am going to ask about like bowel and skin. So yeah, always through like a checklist I think” (p#10)*

It is a resource intensive strategy in terms of both time and cognitive load. Exhaustion is typically a cognitive strategy of novices, however, experts occasionally also resort to it in the face of high levels of uncertainty (Croskerry, 2002). According to Croskerry, it reflects the high degree of uncertainty experienced by novice students (Croskerry, 2002). Considering the inherent uncertainty of primary care setting that students are exposed to for the first time during the Simulated Surgeries, it is likely a highly liable account.

The finding that penultimate year students tend engage in a predominantly hypothesis testing approach also resembles the previous findings of a study from Maastricht University (Prince et al., 2000). There, they found that students at the transition from pre-clinical to clinical years are faced with the realization that they have learned everything backwards (Prince et al., 2000). While their textbooks are organized in a way where they go from disorder to characteristic signs and symptoms, in real life they are presented with the signs and symptoms first, from which they need to find the corresponding disease. The present study found that this discrepancy becomes problematic when students are first asked to move from taking history only to solving

the diagnostic case. **The present findings suggest that it is not necessarily the pre-clinical to clinical transition per se, but rather the transition from history to diagnosis where students will face problems.** When they are asked to connect history with diagnosis, they are then expected to mobilize and re-organize the knowledge they stored thus far in a backward way (Prince et al., 2000). However, this can be very challenging for novices, especially without appropriate guidance. Therefore, when students enter into clinical practice and they first attempt to make a diagnosis, they often apply their knowledge in the way it was originally stored, in a backward fashion from disease to symptoms. This results in a predominantly hypothesis-testing approach, whereby they are searching for confirmatory information rather than falsification for their diagnostic hypothesis.

*“...I got into a roll of questions that I remembered suddenly, cause the ones that I memorized for my third-year exams, it all came back and then rattled through some, appetite, sleep, mood, all that” (p#7)*

Students recall various differentials based on the most salient symptom that is identified as the presenting complaint. They then try to test those differentials by recalling the corresponding signs and symptoms and checking for their presence.

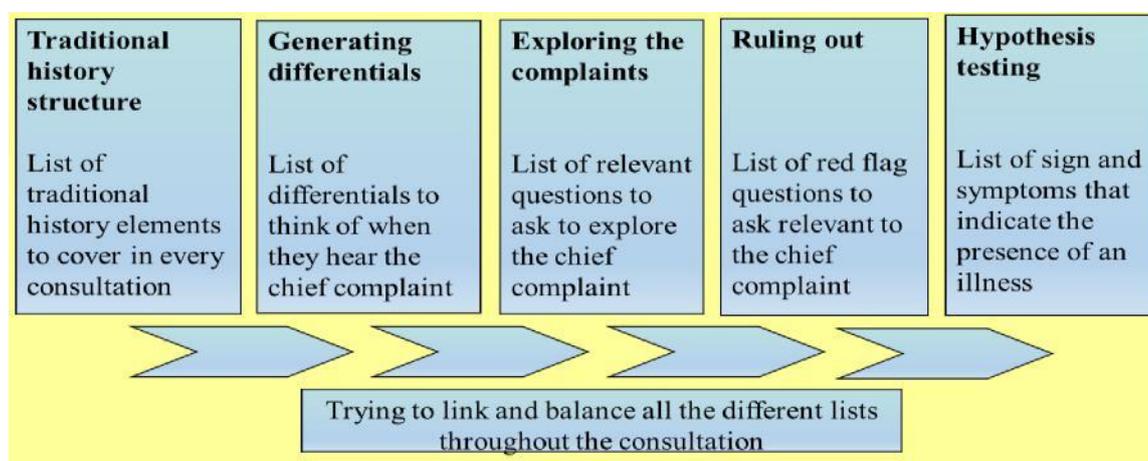
In the present study it was also observed that students were often **trying to hold two or more differentials in mind** at once while trying to decide which differential was the most likely based on the emerging information. This is an approach that involves the use of **hybrid cognitive schemas** (Blissett et al., 2017). It requires the individual to keep many pieces of information in their working memory simultaneously and thereby it created a high cognitive load. Also, the success of this approach depends on the **knowledge of discriminating features**, those key signs and symptoms that differentiate between illnesses with clinically similar presentation. However, at times, the students' knowledge deficits restricted the usefulness of such strategy.

Another finding was that students often **continue generating differentials** even when they have a strong working diagnosis in mind. This is in line with their exhaustive hypothesis testing strategy, which has the best chance of identifying the correct diagnosis when the list of differentials tested is the broadest. While some students perceived keeping an open mind as a positive strategy, others admitted this being a sign of not being confident in their diagnostic conclusions yet. These are consistent with previous studies that found that while early novices tend to engage in premature closure,

**advanced novices keep an open mind but to the cost of not being able to arrive at a definite conclusion** (Cuthbert, 1999).

As opposed to previous suggestions that medical students use extensive biomedical explanations when reflecting on clinical cases (Patel et al., 1990), in the present study, students relied mainly on **memorized checklists of relevant signs and symptoms** when explaining their diagnostic process. One striking feature of the students' diagnostic approach was the sheer amount of various checklists they were trying to keep in mind and balance during the consultations (See *Figure 12*).

*Figure 12: Medical students' reliance on checklists*



These memorized checklists included (1) lists of differentials to consider when presented with the chief complaint, (2) lists of relevant questions to ask to explore the chief complaint (3), lists of traditional history structure elements, (4) lists of red flag questions and risk factors relevant to the chief complaint, and (5) lists of signs and symptoms relating to various differentials. **Most of these checklists are reflecting a 'chief complaint' driven approach.**

*"...I think I need to develop my skills, in terms of, here is the list of questions I need to ask for a particular condition, and I need to remember all those screening questions..." (p#2)*

Students were seen constantly trying to balance and synchronize the use of all these separate frameworks during the diagnostic process. This clearly shows that the diagnostic process is very demanding at this stage of their training, and that the automatization of these frameworks has not yet occurred. A recent study by Daniel-Underwood (2016) where they looked at senior medical students performance at a

simulated ICU setting also found that students performed at a novice level based on Dreyfus' skills acquisition model, which is characterized by a rigid, rule-following, acontextual approach (Daniel-Underwood, 2016).

However, it is unlikely that students could keep all these checklists in mind at once due to the inherent limitations of human working memory capacity. Researchers have argued that individuals can only keep a very limited number of items in their working memory at any given time (Miller and Kintsch, 1994, Cowan, 2001). One of the most consistent findings of working memory research has also been that working memory capacity is highly related to reasoning abilities (Chuderski, 2015, Chuderski and Necka, 2012). During the diagnostic reasoning process, students need to move information from their long-term memory to their working memory in order to make it available for the reasoning process. This has been confirmed by fMRI studies which showed that when novices solve clinical problems, they tend to show increased prefrontal cortex activation – the area of the brain which is associated with analytic reasoning processes and working memory use (Hruska et al., 2016). However, due to the aforementioned limitations of working memory, students wouldn't be able to keep in mind multiple checklists at once, which in turn would imply that they have to keep alternate between them during the consultation.

There are also face further **challenges related to the use of such checklists**. These include (1) being able to recall all the relevant questions on these checklists, (2) knowing the diagnostic relevance of these questions, (3) and interpreting the information collected through these checklists. These challenges largely limited the diagnostic competence of penultimate year students in the present study. Not remembering all the items of symptom checklists makes them less reliable as a diagnostic aid. Not knowing the relevance of questions and how to interpret the information collected through those questions renders these lists to be mere information gathering devices instead of diagnostic aids.

During the simulated consultations, students were asked to use **examination findings and test results** as part of the diagnostic process. The IPA findings showed that while some students were competent at this task, others struggled with it. At times, students did not know how to interpret the test results, at other times they interpreted the test results in line with their working hypothesis instead of using the test result to test the working hypothesis, leading to cognitive biases.

*“...I didn't know that leukocytes and proteins would be indications for UTI, and then I was looking at the pH and I was like not really sure what that means...but to be honest at this point I was just like barrelling down to the UTI, I have decided that it was UTI.” (p#1)*

The presence of such confirmation bias is consistent with the existing literature on novice medical students (Cuthbert et al., 1999). There were further instances of **cognitive biases** observed during the consultations, including premature closure, recency effects, and posterior probability bias (Croskerry, 2002). However, during their reflections, most students did not indicate any awareness of such biases, and neither did they mention any deliberate de-biasing attempts. This is particularly important, because according to the recent study by Krupat et al. (2017), diagnostic accuracy is associated with the openness and willingness to change diagnosis in light of contradicting evidence (Krupat et al., 2017). These findings reflect the importance of overcoming reliance on diagnoses generated through cognitive shortcuts in order to improve diagnostic accuracy.

In the present study, some of the **interpersonal and communication skills** of medical students also showed signs of deficits during the simulated consultations. Some students found it difficult to bring up sensitive issues, failed to translate medical jargon into lay terms, reassure patients without dismissing their worries, or reading the body-language of the patient correctly. Breaking bad news to the patients was also mentioned in the survey results as one of the main challenges of fourth year students.

Many students found it difficult to think while trying to keep the conversation going with the patient. Students' thoughts were often revolving around what questions to ask next and how their non-verbal behaviour was perceived by the patient.

*“...I think at this point, I was thinking of the next questions, so I don't actually remember the answer he gave to that question.” (p#6)*

This **metacognitive interference** was confirmed by the survey results as well. While metacognition is considered to be vital skill for the development of sound diagnostic reasoning skills, the present data indicates that engaging in metacognition during consultations can interfere with the students' ability to attentively listen to the patient. As they find it **difficult to balance thinking, talking and listening skills**, their metacognition was at times distracting for them instead of helping them.

*“...I am really floundering here...I am trying to think and talk and it’s just so hard” (p#7)*

This is similar to the findings of a recent focus-group study, where year 5, pre-clerkship students from a seven-year integrated undergraduate medical curriculum at Ghent University expressed difficulties with balancing attentive listening and medical problem solving during simulated consultations (Aper et al., 2015). However, the findings of the survey also indicated that this metacognitive interference is characteristics of situations of assessment, or perceived assessment in the case of simulated consultations. A possible mechanism for this would be that metacognitive interference increases the cognitive load of the task. During these assessment scenarios, students feel obliged to adhere to multiple checklists in a limited timeframe, are trying to predict patient response, and experience heightened anxiety, which in turn may overload their cognitive capacities. In real consultations, where they have a longer time to think, are less obliged to follow checklists and experience less performance anxiety, metacognition no longer seems to interfere with their performance.

### 6.2.1.2 Final year students' diagnostic reasoning

The diagnostic consultations were initiated in a similar way by final year students as by students in their penultimate year: they **generated initial diagnostic hypotheses early on** during the consultations. At times they were using patient notes to develop these diagnostic ideas, **without explicit awareness of the relating cognitive biases**. The survey findings revealed that like penultimate year students, final year students find the broad range of diagnostic differentials that can present in primary care as one of the main challenges of the diagnostic process. They find it **difficult to know whether they have considered all the relevant differentials** relating to the presenting complaints. These findings are consistent with the study by Hastings et al. (2006), where they found that the most commonly observed weakness of final year medical students' consultation skills was being able to generate appropriate working diagnoses during primary care consultations (Hastings et al., 2006).

Participants in the present study also stated that they find it challenging to then narrow down the initial list of differentials, due to the broad range of differentials that may present in a primary care setting. However, they **no longer seem to accumulate information based on standardized questions as during the OSCE-like scenarios**, instead they were purposefully asking questions that they considered relevant and helpful in order to progress their diagnostic reasoning. They also seemed to be continuously evaluating the information collected from the patients instead of accumulating or ignoring pieces of information.

Based on the present findings, clinical experience helps final year students to develop a more authentic understanding of the complexity of clinical presentations. They **start to consider individual symptom variations and atypical cases** during the diagnostic process. They are starting to understand that the mere presence or absence of a single symptom should not be regarded as strong evidence for the presence or absence of an illness. They also **start considering the possibility of multiple conditions** at once, instead of always thinking in terms of single, acute illnesses.

*"...I think that's what I am trying to get my head around this year, you know if you ask a second year or third year, it's very much they have pneumonia, whilst it could be that they have pneumonia and malaria or and PE, so trying to ask questions to really narrow it down, see if there are two things going on, or one thing going on" (p#13)*

These findings seem to support the knowledge encapsulation process proposed by the knowledge structure paradigm (Schmidt and Boshuizen, 1993a).

The present findings also suggest that students are starting to perceive a greater **discrepancy between the questions they are supposed to ask during OSCEs and the questions they would ask during real consultations.**

*“... So, usually, for like exams we do have a list of questions that we just ask, but of course this is not an exam, and this is like a continuity of care, so you don't want to just bombard them with irrelevant questions...” (p#14)*

While fourth year students tend to ask all the questions on their various checklists even when they do not know why they need to ask those questions, when they transition into real practice in their final year and during their foundation training, they increasingly leave behind questions they do not find useful or relevant. They also become **less likely to cover all the red flag questions in every consultation** unless they seem particularly relevant based on the patient's complaints. This has important implications for medical education, as it highlights the crucial importance of making sure students understand why they are supposed to ask certain questions in various situations. **If they do not know the significance of the questions they may stop asking those questions before realizing the true value of them.** For example, one of the final year students expressed doubts over the usefulness of the standard “*ideas, concerns and expectations*” question, and was hinting at not planning to use it in the future.

*“...I never ever seen any of the qualified doctors approach the ‘ideas, concerns and expectations’, I still do because I still have time to, however, I don't think I have ever seen it be of benefits thus far...” (p#13)*

However, Foundation doctors pointed to the importance of such questions and how they can be very useful during the consultations. This shows that the students' lack of awareness of the usefulness of certain questions does not necessarily mean that the questions is actually useless, it may be that they do not know its clinical value yet.

One **common observation across all year groups** was that participants found it **difficult to deal with an unfamiliar case** that they had no previous experience with. When faced with unfamiliar problems, they found it challenging to separate noise from signal, and were **unable to recognize the diagnostically relevant features** in the

history. The final year participant in the present study found it difficult to establish a strong working diagnosis when faced with a complex case, and instead generated a broad range of differentials based on different signs and symptoms of the clinical presentation. This is contrary to earlier studies which found that advanced novices tend to generate differentials based on the same finding (Arocha, Patel, Patel, 1993). The present findings suggest that final year students show signs of knowledge deficits that prevent them from generating multiple differentials related to the same sign or symptom.

When dealing with a complicated case in primary care, final year students may move back and forth between differentials without being able to narrow down the list of differentials.

*“...So that was me again moving back to pulmonary embolism... back towards the infectious cause or at least an inflammatory cause or something...Moving back towards PE, just to really, what’s the phase I am looking for, to re-convince myself that it is not a PE or anything like that”  
(p#13)*

In the present study, the final year participant was **partially ruling out differentials, then changing the hypothesis testing midway through when new information was presented which activated another differential**. This suggests that their analytic reasoning approach is less linear and more chaotic, which is consistent with the theory of bounded rationality (Ferreira et al., 2010).

On the other hand, participants demonstrated open-mindedness and when presented with conflicting new information, they incorporated the information into their working hypothesis and changed the hypothesis instead of ignoring the information and sticking with the original differential, which was observed in the case of penultimate year students.

*“...that suddenly made the flowchart going down in my head completely re-route” (p#13)*

When **dealing with uncertainty**, final year students showed various coping strategies, such as documenting the case thoroughly and safety netting. The continuity of care model was perceived as helpful as it meant the diagnostic process did not need to end

with the end of the consultations and students were able to utilize safety netting by calling back the patients if necessary. Also, both final year students and foundation doctors were confident in turning to their supervisors for help, and their supervisor's advice helped them to proceed with the diagnostic process. This was in sharp contrast to the perceived helplessness and anxiety of fourth year medical students when faced with such uncertainty in their Simulated Surgeries. However, in the survey, students expressed concerns over the limited availability of help from colleagues in primary care setting and a perceived pressure to work independently, unlike in secondary care settings where help is readily available and the diagnosis is often a results of team effort.

Finally, both penultimate and final year medical students indicated that in real primary care setting, reaching a precise diagnosis is not necessarily the primary goal. **They see primary care as a setting where the main task is to rule out serious conditions and decide about the need for referral.** They are also aware that clinicians in primary care routinely use the test of time and test of treatment as part of the diagnostic process. During the filmed consultations, students seemed confident in managing common problems, however, at times lacked knowledge relating to management protocols to more complex, or unfamiliar cases.

Their management choices at times conflicted with the supervisors' choice, as students were more likely to suggest a more cautious course of action, which involved ordering more diagnostic tests or hospital referral, while their supervisors suggested the use of test of treatment and test of time. Goyder et al., (2015) suggested that some individuals may have a lower tolerance of uncertainty, perhaps relating to personality traits, which prompts them to order more tests, even when those would not be necessary (Goyder et al., 2015). They also suggest that students need to come to terms with and accept the level of uncertainty that characterizes primary care practice.

### 6.2.1.3 Foundation trainees' diagnostic reasoning

Once over the graduation transition, it was apparent that Foundation doctors no longer treat primary care consultations in isolation. They utilize the continuity of care model of primary care and spread the diagnostic process over several consultations when necessary. When taking history, they no longer stick rigidly to the traditional history structure. They are more likely to ask questions that they considered to have diagnostic value with regards to the case at hand, instead of relying on mnemonics and checklists. They are conscious of making sure to clarify patient information, demonstrating awareness that sometimes patients say one thing, but mean another.

There seems to be a **shift towards a 'ruling-out worst-case scenario' (ROWS) approach** in the diagnostic process, which is more suited to the time constraints of a primary care consultation.

*"... you think of the worst and you hope for the best, and that's the balance you play with in general practice" (p#16)*

ROWS, also known as *restricted rule-out* or the *Murtagh's process*, is a reasoning strategy, which involves ruling out the most serious differentials first, in order to avoid serious diagnostic errors (Murtagh, 1990, Heneghan et al., 2009, Croskerry, 2002). This strategy is frequently used by primary care professionals (Heneghan et al., 2009). It is a strategy that is more adaptive to the time constraints of primary care consultations than exhaustive hypothesis testing, and indicates more advanced diagnostic reasoning skills.

Foundation doctors were **using physical examination and ordering diagnostic tests confidently**, however, they were **becoming less thorough** with regards to basic physical examinations during the consultations. They also **considered it unnecessary to always rigorously cover all red flag questions in a primary care setting**, unless it wasn't directly indicated by the history, as they thought bringing up red flag symptoms could be disconcerting for the patients. They also believed that patients would bring up serious signs and symptoms without being asked.

*"...I wasn't very good at my red flags, I think I asked one red flag at the end. I think in GP you don't. When I was at A&E, I used to ask them all the time, you know, because you have to be safe, and I think really if he had problems with his bowels or weeing or he couldn't feel his bum then he would have mentioned it." (p#15)*

While penultimate medical students were not yet comfortable at relying on their clinical judgement, it was an important part of the diagnostic process for Foundation doctors. They considered their role of autonomous judgement and decision making based on the history and examinations as an important part of their professional identity. They also showed some emerging awareness of cognitive biases and strategies to avoid them. They were aware of some cognitive predispositions such as having preconceived ideas early in the consultations based on the initial information and they were **consciously reminding themselves to challenge** those **preconceived ideas**.

*“...patients often come in with a single problem and you often have a very preconceived idea about what their, what their final diagnosis is, um and it’s often a little bit, you have to remind yourself that yes, it is your initial thought process, but when you don’t subsequently find it in your history and then in your examination, I think that is the most important part”  
(p#15)*

They also considered regular supervision as an effective strategy to safeguard against cognitive errors.

While medical students during their fourth-year simulated practice showed deficits in consultations skills, the foundation year participants were **confident in both interpersonal and communication skills**. Their metacognitive thoughts were not revolving around how to translate medical jargon into lay terms or how to reassure patients, nor was it revolving around their own non-verbal communication. While penultimate year students found it difficult to balance thinking and listening during OSCE, our survey results revealed that they do not seem to struggle with these skills when in real clinical practice. The reflections of Foundation doctors revealed the importance of them learning to balance these skills.

Based on the present findings, Foundation doctors realize the **importance of active listening** in order to achieve patient centred care.

*“...I think it is important to be inquisitive, I think it is important to have an open mind...using your consultation skills that you have learned and trying to ask nice, open-end questions to allow the patient to talk (p#16)*

They understand that listening to the patient not only serves the diagnostic process, but also has the psychological function of making the patient feel listened to. Also, “*ideas*,

*concerns and expectations*”, which seemed like an OSCE box during the undergraduate years, now had great importance. It helped them assess the patient’s understanding of their own condition and guide the consultation to achieve mutual understanding between doctor and patient.

The **patient-doctor dynamics** was another element of the consultations that penultimate students did not yet consider during their simulated exercise, but received much more importance in real practice. While final year students showed emerging understanding of the importance of patient-centred care through achieving mutual understanding and shared decision-making with the patients, Foundation doctors demonstrated an even deeper level of understanding of the patient-doctor dynamics. They were aware that the consultations have complex dynamics, where they need to balance their rapport building, nurturing, and empowering role while being cautious of patients becoming over reliant on their clinicians. They balance negotiations with patients to achieve mutual understanding and shared decision making. Finally, they consciously tried to prevent patients becoming frustrated with the diagnostic process and they were also aware of increasing accountability which made them even more conscious of safety netting and safe practice.

Another element of the consultations skills that changed through the years was the incorporation of the **use of online resources** during the consultations. During the penultimate year, students were not allowed access to computers and therefore could not utilize online resources during their Simulated Surgeries. During final year placements, students has access to computers, but their use of online resources was limited to administrative tasks and filling in their knowledge gaps through unofficial websites. In foundation year, on the other hand, participants seemed to be more confident to utilize online resources to the maximum. It not only helped them address gaps in their knowledge using official websites for medical information, they also used these resources to help patients accept and understand their diagnosis.

*“... it becomes a bit more real when it’s not just you’re saying it, but the computer with all the world of information is saying it to them as well.”*  
(p#16)

The use of online resources was integrated into their consultation skills, however, they admitted that at times it can be difficult to balance the time spent looking at the computer and listening to the patient.

Finally, Foundation doctors tended to **place more emphasis on the management** part of the consultation, as they were aware that a diagnosis is not always reached in primary care.

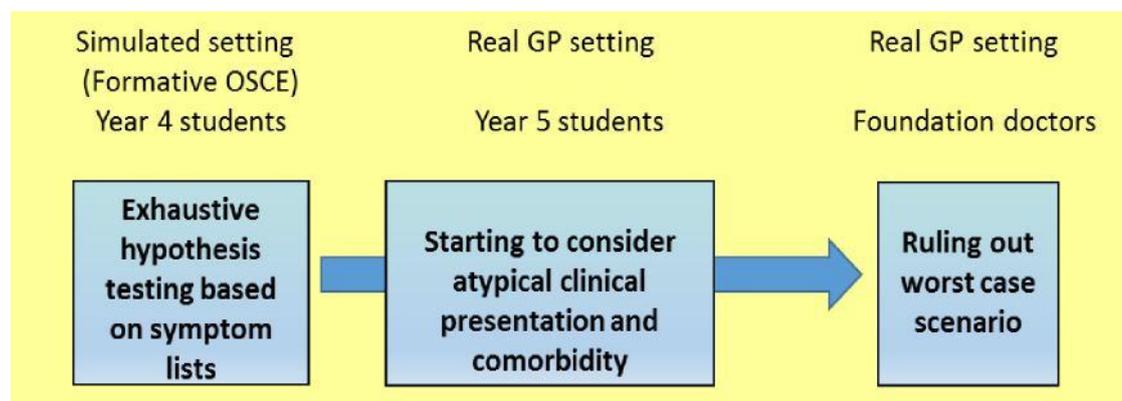
*“... Yeah, I think quite a lot of the time, when you are a medical student, you are always focused on what the diagnosis is, but when you get into practice it is really not what’s important. I think you just need to be able to do your part.” (p#15)*

They were aware that they need to be able to plan management even in the absence of a diagnosis, using test of time, test of treatment, or triaging. Foundation doctors seemed confident in managing patients’ problems in primary care. They explained that it was the opportunity to practice in real setting and being allowed to take on the decision-making responsibility that helped their management skill development and confidence the most. During the observed consultations, they tended to use a hierarchy of treatment plans, whereby they offer the least intrusive treatment first, and only step up the treatment ladder if the least intrusive treatment was proven to be unsuccessful. However, when there was significant risk involved, they tended to choose the safer management option right away. Finally, they also utilized safety netting and turning to their supervisors for help in order to ensure safe practice.

#### 6.2.1.4 Summary

All in all, the present study has highlighted many characteristics of the diagnostic reasoning skills of senior medical students approaching the graduation transition and newly qualified doctors in a primary care setting. The main findings are summarized in the *Figure 13* and *Table 11*. The present study highlighted that there are some important differences and similarities in the diagnostic approach of participants from these different year groups. However, when interpreting these findings, it has to be taken into account that the fourth-year participants were observed in a formative OSCE setting which may confound the findings. Furthermore, the Foundation trainees graduated from a different medical school than the undergraduate participants of the study, which also may confound these findings. Therefore, further research is necessary to find out to what extent these findings are true for larger population of medical students, how much they represent cognitive developmental changes and to what extent are they attributable to the undergraduate training of diagnostic reasoning.

**Figure 13:** Changes in diagnostic reasoning based on the IPA findings



*Table 11: Summary of main findings from the IPA studies*

Year 4	Year 5	Foundation Year 2
<ul style="list-style-type: none"> <li>• Each consultation follows the same traditional consultation structure</li> <li>• Asking many questions in quick succession without interpreting the answers</li> <li>• Moving beyond their previous history-taking role and taking on the decision-making role for the first time</li> <li>• Introducing diagnostic reasoning to their consultations</li> <li>• Hypothesis-testing approach based on memorized checklists</li> <li>• Deficits in consultation skills</li> <li>• Knowledge gaps restricting the diagnostic reasoning process</li> <li>• Asking questions even when not knowing the diagnostic relevance</li> <li>• Maintaining the original hypothesis in face of incongruent information</li> <li>• Transient use of diagnostic reasoning</li> </ul>	<ul style="list-style-type: none"> <li>• Consultation tailored to the individual</li> <li>• Asking fewer questions during consultations not to overwhelm patients</li> <li>• Considering individual symptom variations and the possibility of comorbidity</li> <li>• Less thorough with red flag questions</li> <li>• Using online resources to compensate for knowledge gaps</li> <li>• Ruling out serious conditions and triaging as primary care goals</li> <li>• Observing discrepancy between their training and real clinical practice</li> <li>• Changing the diagnostic hypothesis when faced with incongruent information</li> <li>• Struggling to recognize diagnostically relevant information when faced with unfamiliar problem</li> <li>• Knowledge gaps and clinical skills deficits in certain domains</li> <li>• Starting to consider patient-doctor dynamics</li> </ul>	<ul style="list-style-type: none"> <li>• Diagnostic process stretched over several consultations</li> <li>• Ruling out worst case scenario approach</li> <li>• Using test of time and test of treatment</li> <li>• Clinical judgement as essential part of the diagnostic process</li> <li>• Using online resources to compensate for knowledge gaps and as integrated part of the consultation</li> <li>• Less thorough with red flag questions and physical examinations</li> <li>• Focusing on management more than on diagnosis</li> <li>• Emerging awareness to cognitive biases</li> <li>• Struggling to recognize diagnostically relevant information when faced with unfamiliar problem</li> <li>• Confident consultation and communication skills</li> <li>• Understanding of the patient-doctor dynamics and the wider GP role</li> </ul>

### 6.2.2 The ‘OSCE effect’

When exploring the diagnostic skills of fourth year medical students, the present study utilized the Simulated Surgeries of the local medical school which provide students opportunity to practice GP consultations in a safe, simulated setting. However, the strongest theme emerging from the interviews with the fourth-year students was that the setting of the Simulated Surgeries closely resembled OSCEs, which in turn prompted the students to share their reflections upon their diagnostic reasoning approach during OSCEs. This allowed us to explore the characteristics of students’ cognitions and behaviours during OSCE consultations. Based on the present findings, the diagnostic thinking and behaviour of senior medical students appears to be markedly affected when placed in an OSCE setting. They perceive various aspects of their diagnostic approach to be different during OSCE consultations in contrast to real clinical scenarios.

The reflective interviews shown that students hold strong beliefs about typical OSCE stations and the expectations they are supposed to meet while completing OSCE stations. They had expectations about the typical complexity of OSCE problems, typical histories OSCE patients would present with, as well as assumptions about how OSCE actors would typically behave in various situations. These **expectations influenced the students’ diagnostic approach** during the consultations.

*“...at that time, I was thinking, you know they gave me an ECG, surely there is something I need to find here...” (p#3)*

They often analysed the consultation in order to predict what was expected of them, which diverted their attention from patient-centeredness. They knew that during OSCEs, different stations tend to assess different competencies (i.e. communication skills, interpretation skills, or management skills), and therefore at times they tried to identify and categorize stations accordingly.

*“...The difficulty that I found with this patient was that I wasn’t quite sure if this was a communication station or if it was a medical station...” (p#8)*

The attempt to categorize and identify stations in order to know what was expected of them, gave rise to a cognitive phenomenon that mimicked pattern recognition, but would be better described as “**station recognition**”, as it involved the student recognizing what tasks they were expected to complete and the skills they would be required to demonstrate during certain consultations instead of activating a corresponding illness script.

“...I knew what they wanted of me in this scenario...” (p#7)

During the Simulated Surgery consultations, students were often focusing on these OSCE-related expectations instead of being immersed into the simulation.

Another consistent finding of the present study was that senior medical students’ strongest reflex associations with **OSCEs included stress, anxiety, and pressure**. Therefore, it was not surprising that many students also experienced stress and anxiety during the Simulated Surgeries which were similar to OSCEs in many ways. However high levels of anxiety were shown to elevate the cognitive load of simulated tasks, leaving less cognitive resources available for dealing with the task at hand (Fraser et al., 2012). Some important characteristics that OSCEs and Simulated Surgeries shared, and which in turn induced stress included: (1) the presence of an authority figure filling out a checklist based on the students’ performance and (2) the time constraint of the consultations. As these characteristics were significantly different from their real clinical experiences, these tended to influence the students’ behaviours and cognitions.

The presence of the authority figure was associated with a strong desire to appear competent during the simulated consultations. They were not only performing in front of their clinical supervisors, they also felt as if they were being assessed based on their performance. To deal with this pressure, **students often tried to appear more competent than they felt, while consciously trying to disguise their uncertainties and weaknesses**. This finding is consistent with previous research, which showed that fear of failure, embarrassment and appearing incompetent are all important motivating factors for adults learners (Sappington, 1984).

*“...I was just thinking to keep asking questions to make it look like you know what you are doing. But I guess that is just not clinical reasoning, if I haven’t had anything in my mind to like direct my thoughts.” (p#1)*

This finding is also consistent with previous research, which showed that medical students deliberately change their communication style during OSCEs in order to deal with the pressures (Malhotra et al., 2009). While there seems to be a high rate of faux competence during OSCEs, during their primary care placements, students more readily admitted their shortcomings and asked for help when necessary.

What added further pressure to the scenario was that the supervisors were not only observing the students, but also filling out a checklist based on their performance during the consultation. The students were familiar with the checklists, as those bore a close resemblance to OSCE assessment checklists. The presence of **the assessment checklist seemed to encourage students to focus on the questions rather than the answers.** Focusing on the questions encouraged a reductionist history taking approach whereby the **students momentarily suppressed their attempts at diagnostic reasoning and asked a list of questions in quick succession in a purely information accumulating style.**

*“...I was on a roll, so to speak, I was just thinking I need to ask this, ask this, ask this, so I wasn’t really putting everything he was telling me together at the time. I think because kind of because of the pressure and I am thinking I need to tick some boxes... I am thinking I need to ask this, I need to ask this, so sometimes I am not necessarily processing the information that I am getting.” (p#3)*

Concerns over such reductionist approach has been raised previously regarding communication skills training in medical education (Silverman et al., 2011, Salmon and Young, 2011). When engaging in such behaviour, students were not processing the information they were gaining, often not even listening to the patient’s answers, as their priority was to tick all the boxes on the assessment checklist. They perceived some of these questions as ones that they were required to ask in order to get a higher score, but that they would not normally ask in reality as they did not perceive them as valuable.

*“...that was more because I thought that would be a mark on the sheet, like for my own diagnosis I didn’t think I need to ask these questions” (p#1)*

Therefore, it appears that assessments that involve simulated patients and checklist type evaluation do not necessarily encourage diagnostic reasoning. Moreover, if it is indeed the case that students can achieve high marks on OSCEs by asking all the right questions they have memorized for set presenting complaints, then these OSCE station allow a contextualized memory recall without a corresponding reasoning element.

*“...OSCEs, it is not really testing diagnostic skills, it is testing the fact that you have learned a list of all the different stations...” (p#2)*

Eva (2005) issued similar caution for clinical teachers: he warned that it should not be assumed that students fully understand the problem at hand just because they state the right diagnosis or management at the end of the consultation (Eva, 2005). Our findings expand on that and suggest that even **asking all the right questions is not a reliable sign that students fully understand the problem and it does not necessarily indicate the use of sound diagnostic reasoning.**

The other elements of the consultation, that added to the pressure was the time constraint. Both the interviews and the survey confirmed that students found the **time pressure** of OSCE consultations very challenging. Based on the students’ reflections, the time limit of the consultations was unrealistically short and often not sufficient to accommodate the students’ analytic reasoning strategies.

*“...you are so time pressured, you can’t really think clearly and...you are only just learning the medical stuff...and then you have got the kind of time pressure to try and remember all anyway, so I would say time is a problem, you just haven’t done it enough to be able to do it quickly” (P#10)*

The time limit during the Simulated Surgeries was similar to that of OSCEs, which was at times too short for the students to consider multiple differentials and therefore they resolved to using anchoring heuristics, focusing on their first differential diagnosis, while missing or ignoring any contradicting evidence, as that would have had to reroute the diagnostic process which they did not have enough time to deal with.

*“...I didn’t know about other differentials, other things, and I didn’t think I had enough time to think of those things, so I just ploughed on with my one differential that I had” (p#7)*

Under these circumstances, they do not have enough time to utilize their analytic reasoning strategies, as they feel rushed, they either engage in superficial reasoning or no reasoning at all. The time pressure also meant that they needed to cover the items on the assessment checklist as quickly as possible. Hence **the time pressure together with the checklist style assessment together appear to result in superficial diagnostic reasoning and cognitive biases** instead of sound diagnostic reasoning.

Based on the present findings, senior medical students increasingly see a **discrepancy between the questions they are expected to ask during their OSCE assessments and those they would ask in real clinical scenarios.**

*“...in real life I don’t think you would ask the questions about suicide, but in an exam situation you should” (p#7)*

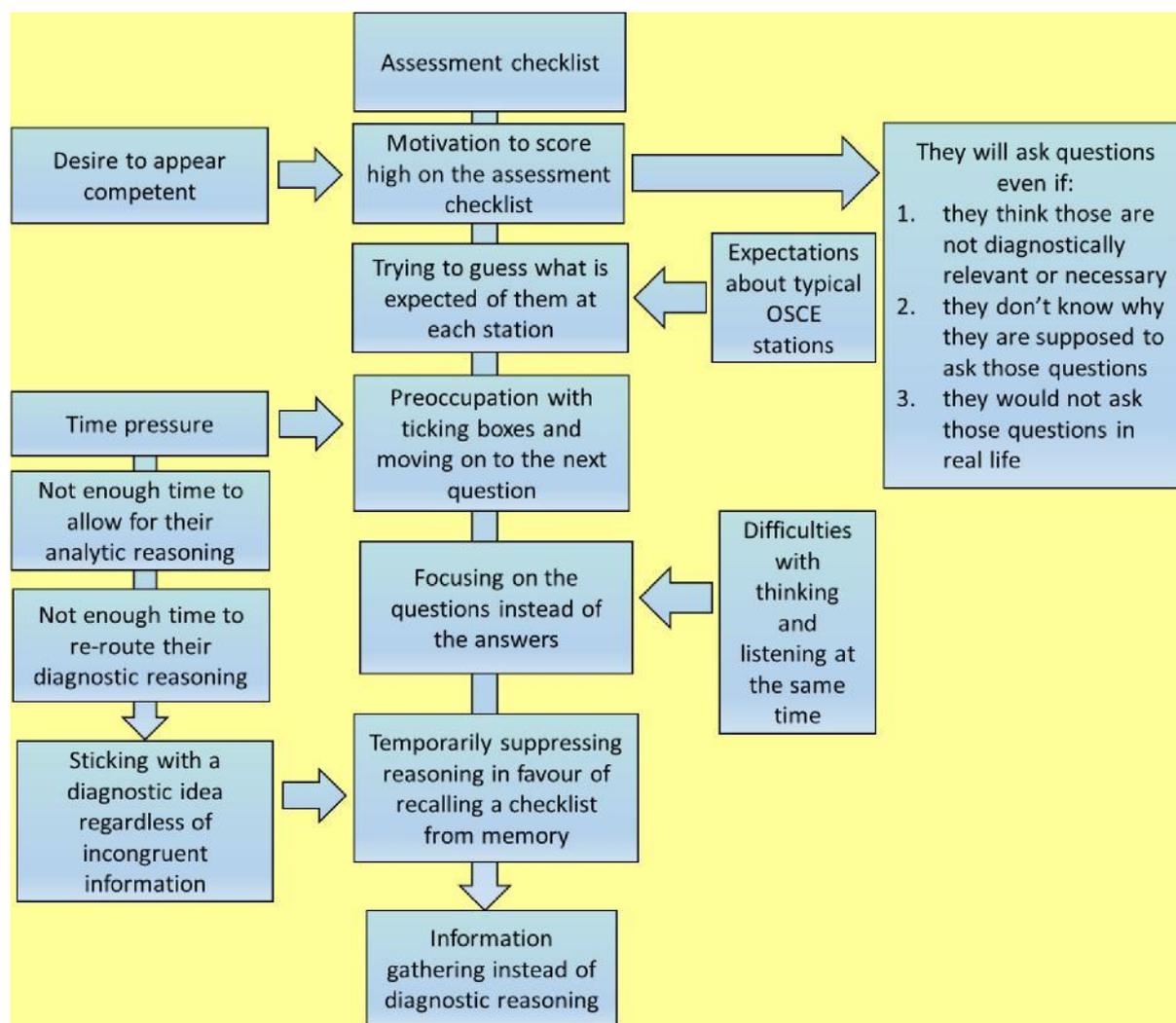
It was reported in a recent systematic review that history taking skills seem to decline over time throughout the undergraduate years (Keifenheim et al., 2015). Based on the present findings, this decline may be partly due to students increasing perception of the difference between what they are taught and what clinicians do in real patient encounters. At the same time, it was also observed that in real practice, junior doctors do not tend to ask questions they do not perceive relevant or useful. Therefore, one potential issue arising from the perceived discrepancy between what is taught and what is perceived as relevant, is that students may stop asking those questions they do not see as relevant once they leave behind the box-ticking approach of their undergraduate training. In fact, students highlighted their desire and intention to part ways with the rigid tick-boxing approach when they are faced with real patients, as they do not see it as appropriate. However, it may be the case that those questions that students perceived as irrelevant actually do serve an important diagnostic purpose from the experts’ point of view, only the students lacked knowledge of that association.

*“...I think my diagnostic skills are at a stage today where I know the questions, and I will ask those questions, and sometimes I am not quite sure why I am asking questions exactly.” (p#2)*

This highlights the importance of explaining to students the usefulness and diagnostic relevance of questions they are supposed to cover during various consultations.

To sum up these findings, a theoretical model based on the contextual influences of the OSCE setting on the students' diagnostic approach has been designed and named "**The OSCE effect**" (See *Figure 14*). This model shows that students' desire to appear competent in front of their supervisors makes them want to achieve high scores on their OSCE checklists, as a high score is typically seen as a sign of competence. However, their motivation to score high on the checklist leads to asking questions even if they do not think those questions are relevant or necessary, even if they do not know the value of those questions, and even if they would not ask those questions in a real clinical scenario. Becoming preoccupied with the checklist means that they focus their attention on trying to figure out what is expected of them in that artificial situation, instead of adopting a patient-focused attitude. This is intensified by their defined expectations relating to typical OSCE stations and patient profiles. The time pressure of the OSCE stations puts further pressure on the students to tick all the boxes on the checklist before the time runs out. However, that leads to students focusing much more on what question to ask next, instead of focusing on how to interpret the answers the patients are providing to their questions. This is intensified by their difficulty of thinking and listening at the same time. The contextual pressures of OSCEs make them prioritize the recall of memorized station questions, while temporarily suppressing attempts at diagnostic reasoning. There is also a discrepancy between the time pressure of these consultations and the students' diagnostic reasoning ability. At this stage of their cognitive development predominantly rely on analytic, hypothesis testing strategies, which are time consuming. However, the time pressure of the OSCE stations does not seem to allow for students to rely on these skills, depriving them of the only reasoning strategy they currently possess. Therefore, even when students encounter information during the consultation that does not support their working diagnosis, they do not always have time to re-route their reasoning and therefore end up adopting the initial diagnosis regardless of incongruent patient information. All in all, the contextual pressures typical in a time-restricted, standardized patient OSCE assessed through checklists seem to encourage an information gathering approach instead of active diagnostic reasoning.

**Figure 14: The 'OSCE effect'**



The OSCE effect can also be understood in terms of the dual process theory of diagnostic reasoning. According to the dual process theory, clinicians either immediately recognize the problem via pattern recognition, or engage in analytic reasoning in order to solve the diagnostic puzzle. It is proposed that pattern recognition is dependent on clinical experience, takes time to develop, and therefore, medical students predominantly use analytic reasoning strategies. According to the present data, contextual factors influence these processes. When students are situated in an OSCE setting, both their analytic and non-analytic reasoning strategies can be affected in the following ways:

□ **Station recognition instead of pattern recognition**

The present findings suggest that due to the limited experience of students, they are unlikely to use pattern recognition very often. On the other hand, they do engage in a cognitive process that mimics pattern recognition: they often recognize the station

and are able to recall the skills and competencies they are supposed to demonstrate as well as the questions they are supposed to ask when coming across that specific station. Recognizing the station triggers their memory of memorized questions they need to ask when faced with the presenting complaint. However, this is not the same as pattern recognition, where clinicians recognize the illness scripts.

#### □ **Ticking boxes instead of hypothesis testing**

Students have the tendency to generate hypothesis early on in the consultations. This is followed by further information gathering. However, due to the checklist assessment, their difficulty with thinking and listening at the same time, and their lack of understanding how incoming information would influence the likelihood of their working hypothesis, their hypothesis testing often hinders their intended hypothesis testing approach. In these instances, they resort to an information gathering as opposed to hypothesis testing and verification. Furthermore, the time limit of the consultations means that they think they do not have enough time to run multiple cycles of the hypothesis testing and therefore stick with their initial diagnosis whether it was fully justified by the data or not.

While the ‘OSCE effect’ was a consistent finding in the present study, it has some limitations. Since the present study was not placed in a real OSCE setting, the model proposed here may only cover a fraction of the real OSCE experience. Therefore, in order to fully understand how the setting and procedures of OSCEs influence students’ cognitions and behaviours, future studies should explore the lived experiences of students during real OSCE scenarios. Also, it should be stressed that the present findings do not mean that OSCEs are inadequate at assessing clinical competencies. It rather suggests that educators need to be careful when selecting which clinical competencies can and cannot be assessed through a particular OSCE. It has been shown that well designed OSCEs can reliably assess various clinical skills (Berendonk et al., 2013, Swanson and van der Vleuten, 2013). However, **based on the present findings, it is unlikely that OSCEs with simulated patients and checklist-style assessment would be suitable to evaluate the students’ diagnostic reasoning skills.** At most, these OSCEs work as a contextualized knowledge tests, but memory recall should not be equated with the use of reasoning skills. If medical schools are interested in testing their students’ diagnostic reasoning skills, more appropriate assessment strategies need to be introduced. Finally, the present findings do not mean that medical students do not engage in any type of reasoning at all during simulated consultations and OSCEs.

Instead, the present findings suggest that the combination of the expectations of OSCEs, the motivation to score high, and the contextual pressures often overwhelm the students and elicit cognitions and behaviours that are different from the ones they would demonstrate in real clinical settings. In order to deal with all these pressures, students may cope by ticking boxes instead of engaging in reasoning. On occasions when they do engage in reasoning, it tends to follow the pattern described at the start of this chapter.

### 6.3 PRACTICAL IMPLICATIONS

The findings of the present study have several practical implications for medical education. First, the findings have implications for the undergraduate curriculum design. They highlight the need for improved diagnostic reasoning training for senior medical students and provide guidance on when and how to incorporate this training into the curriculum. Furthermore, the findings also highlights some key issues that need to be addressed when setting up simulated practice in order to facilitate the use of diagnosis reasoning. Finally, implications for the assessment of diagnostic reasoning skills in medical education and the use of OSCEs are discussed.

#### 6.3.1 Lessons for curriculum design

##### *6.3.1.1 Recommendation 1: Aiding the transition from hospital to primary care setting*

The present study has important implications for undergraduate curriculum design for senior medical students. First of all, the findings indicate that senior medical students find the diagnostic role in primary care challenging and therefore could benefit from additional support in adapting to the constraints of the primary care setting. When teaching fourth year medical students, primary care educators need to be aware that students enter their classes with a predominantly secondary care experience and **they could benefit from guidance on how to adapt to the specific characteristics of the primary care setting.**

Students find the transition into the primary care setting challenging, because the diagnostic process is perceived to be very different from what they are used to during their secondary care experiences. Due to the various challenges of the transition from secondary care to primary care, educators need to be mindful of these challenges and help students make the necessary adaptations in their diagnostic approach. When they transition into primary care, they no longer have rapid access to diagnostic tests, lab results and scans, but instead they have to rely on the history, clinical presentation, and physical examinations. The finding that senior medical students find this aspect especially challenging suggests a reliance on diagnostic tests. The advantage of diagnostic tests is that they can be used to confidently confirm or rule out a diagnosis. When this route is not available, the students have to rely on strategies that involve a higher level of uncertainty. Students' aversion to diagnostic uncertainty makes it challenging for them to adapt to these circumstances. Students also have to become

more independent in primary care settings and learn to take charge of triaging decision. Judging whether referral is necessary, using test of time and test of treatment are all common tasks in primary care.

Finally, they have to adapt to the time constraints of the consultations. Their previous strategy of thorough and extensive history taking needs to be replaced with brief, focused history. Their exhaustive hypothesis testing approach can be problematic for a vague domain such as primary care. An exhaustive hypothesis method works best when a wide variety of differentials is considered, however, due to the broad variety of possible differentials in primary care, generating a broad enough list of possible differentials can be difficult and time consuming. Other type of reasoning strategies, such as 'Ruling-out-worst-case scenario' could be more appropriate in a primary care setting (Croskerry, 2002, Heneghan et al., 2009). This strategy is based on trying to rule out the most serious, 'not-to-miss' diagnoses. This strategy helps the clinician to focus the diagnostic process by setting a hierarchy of the possible differentials and ruling out the ones on the top of the hierarchy first. It can help the clinician direct the consultation and make it more focused which in turn can help adapt to the time constraints of primary care consultations. At the same time, instead of being pressured to set up a definite diagnosis within 10 minutes of first seeing the patient, students should be encouraged to embrace the continuity of care model with safety netting and spreading the consultations over multiple visits when necessary.

### ***6.3.1.2 Recommendation 2: Aiding the transition from history to diagnosis and management***

Recently, one of the most pressing questions of diagnostic reasoning research has been to decide where exactly in the medical curriculum diagnostic reasoning training should be placed. Some argue for placing it in the pre-clinical years, while others argue for its implementation during the clinical years (Schmidt and Mamede, 2015, Eva, 2005). However, it is not clinical exposure alone that decision should be based on, but rather when is the right time in the curriculum when the students actually start actively engaging in diagnostic reasoning. The present study has identified an ideal window of opportunity for implementing such training based on empirical findings.

Based on the present data, there appears to be an important transition in the penultimate year of training from history taking to making diagnostic decisions. However, the

detachment of diagnosis formulation from history taking has important implications: when taking history without having to consider diagnostic implications, the history taking can follow the same structure each time. It can be rigid and inflexible, involving the same list of standardized questions, always covering the same topics, and collecting as much information as possible. However, when the added responsibility of forming a diagnosis comes along, the history taking process needs to be adapted. If the diagnostic task is just added on and treated as a separate, sequential parts of the diagnostic process that will lead to maladaptive diagnostic reasoning. It will result in the accumulation of large amount of information and subsequent attempts to sift through it all. This is the way novices may approach consultations when they do not yet know any other way. However, in order to engage in more adaptive diagnostic reasoning, the history taking needs to be adapted to accommodate diagnostic reasoning. History taking needs to become purposeful and directed, moving towards a diagnosis. That is why **this transition between history and diagnosis indicates an ideal window of opportunity to implement diagnostic reasoning training.**

Some may argue that this division could be resolved by introducing the diagnostic reasoning element early on and thereby never separating it from history taking on the first place. However, according to a 2015 systematic review on the teaching of history taking skills to medical students, it was concluded that students in the early, pre-clinical years can benefit from the separation of history taking from the diagnostic element (Keifenheim et al., 2015). It is explained that the diagnostic element early in the training would overcomplicate the task for beginners. Therefore, the separation of history and diagnosis may even be advantageous in the early years. However, if diagnostic reasoning is indeed removed from their history taking skills, it is important to reintroduce this when students have mastered the history taking skills. It is important that when students are finally ready to connect these two main elements of the consultation, they should be aided by appropriate training. In the present study, fourth year students were confident and competent in history taking, when separated from diagnostic reasoning, however, when the responsibility of diagnosis and management was introduced and they needed to connect history taking and diagnosis, they struggled. These findings support that students find this transition difficult and could benefit from further training in this domain.

A diagnostic reasoning module at this point should perhaps cover various topics in order to best prepare students for taking on the diagnostic process. *First*, students need to

learn to direct the information gathering instead of relying on standardized question lists. For this **they should revisit the function and diagnostic value of standard history questions, exemplified by various cases, so that the students understand why they are asking the questions.** They should learn about forward reasoning strategies, abstraction, enabling conditions and illness scripts, in order to understand how their reasoning skills are expected to develop over the years. They should also be educated about diagnostic reasoning in order to provide them with the right vocabulary to be able to better recognize and understand their own reasoning strategies.

Second, when students are given the responsibility of diagnosis and management, they have to learn to interpret the incoming information while it is being collected. **They should be aided in interpreting information as they are collecting it, by helping them understand how a new piece of information could influence the working diagnosis.** For this reason, they could benefit from training that targets their skills in interpreting clinical information, such as script concordance tests. Such exercises could help students learn to make sense of examination findings as well, which according to the present data year 4 students can struggle with. During script concordance tests, participants are asked to decide how likely the diagnosis becomes when presented with a new piece of information. They need to indicate the likelihood of the diagnosis on a range from -2 to +2, where -2 indicates that the new evidence makes the old diagnosis very unlikely, while +2 indicates that the new piece of evidence is strong support in favour of the old hypothesis (Humbert et al., 2011). These exercises could be beneficial for students who have difficulties with interpreting information in a diagnostic way during a consultation.

Finally, it is not only in the classroom where diagnostic reasoning training could be incorporated into the curriculum. Clinical placements could be ideal settings to demonstrate and teach about diagnostic reasoning. First of all, it is important that clinical tutors explain their own diagnostic reasoning to medical students when they are on their various clinical placements. **When students observe their clinical tutors not asking certain questions, or making shortcuts, they may wrongly conclude that certain questions that have been skipped are unnecessary,** when in fact those could be relevant for their level of diagnostic reasoning and not recognizing the cognitive shortcut made by the senior clinical. In addition, students should be encouraged to ask about the discrepancies they observe between their formal training and clinical training in order not to draw mistaken conclusions. It is important that **feedback should be**

**provided not only by stating the questions they should have covered during the consultation, but a detailed explanation for why they need to ask those questions and how different answers could have been interpreted for those questions.** This would help illuminate the underlying diagnostic reasoning process for the students. Previous studies have also emphasized that it is important for clinical tutors to explain the students the diagnostic relevance of various findings during consultations in order to facilitate the students' diagnostic reasoning (Bowen, 2006, Wigton et al., 1986). The present study highlights the empirical relevance of these guidelines for facilitating diagnostic reasoning. Finally, since the diagnostic process is observed to be so distinctively different in primary and secondary care settings, it may be useful to separate these through different modules.

There is emerging evidence that these recommendations for increased, analytic diagnostic reasoning training for senior medical students could have positive effects. In a randomized control study in 2013, Myung et al. wanted to find out whether enhancing the analytic reasoning of fourth year medical students could result in better diagnostic accuracy scores (Myung et al., 2013). They found that the mean diagnostic accuracy score significantly improved for the group where students were asked to provide differentials diagnoses and both compatible and non-compatible findings that are relevant to those during consultations compared with the control group, where they were not asked to provide such information. The findings of the present study may explain why this analytic reasoning intervention for fourth year medical students was successful and they are also in line with the recommendations for increased analytic reasoning training for fourth year medical students.

### ***6.3.1.3 Recommendation 3: Aiding clinical skills and knowledge***

With respect to clinical skills, fourth year students found certain consultation skills especially challenging. Many previous studies have raised concerns that without continued training, interpersonal and communication skills of medical students can deteriorate during their senior undergraduate years (Hook and Pfeiffer, 2007, Craig, 1992, Engler et al., 1981, van Weel-Baumgarten et al., 2013, Junod Perron et al., 2015). The present findings indicate, that when using stimulated reflection, students' awareness to weaknesses in such skills can surface and help identify learning needs. According to the present study, fourth year medical students **could benefit from further consultation skills training**, focusing on (1) *reassuring patients without*

*dismissing their worries, (2) addressing talking about sensitive issues, and (3) translating medical jargon to lay terms.*

Training medical students to be able to bring up sensitive issues has important implications for the diagnostic process. If the possibility of causing discomfort to patients discourages them from consistently asking about red flag symptoms that may lead to missing serious conditions. It was disconcerting that even FY2s reported that they would not always bring up red flag questions as those would cause discomfort to the patients. They were expecting patients to bring up red flag symptoms if those are present. However, relying on this assumption may also lead to missing serious diagnoses. Therefore, they may need more training that encourages them to disregard their aversion to cause discomfort through screening questions when asking those questions could reveal important diagnostic information. Teaching them the right vocabulary to use in these cases may help them overcome the embarrassment of asking about sensitive issues. Translating medical jargon into lay terms is also necessary in order to achieve mutual understanding with the patient. Students could also benefit from practicing to translate lay terms into medical jargon, as that would promote their abstraction which in turn leads way towards illness script formation (Braun et al., 2017a, Kiesewetter et al., 2013).

Although it has been argued that a lack of knowledge is not a primary cause of diagnostic errors among experienced clinicians (Graber et al., 2005), the present study suggest that in case of penultimate year students, inadequate knowledge can fundamentally limit their diagnostic skills from the beginning to the end of the diagnostic process. A recent Swiss study also found that inadequate knowledge is one of the main causes of diagnostic errors among senior medical students (Braun et al., 2017b). In the present study, students had many gaps in their knowledge relating to relevant sign, symptoms and risk factors, discriminating features, management guidelines and more. Senior medical students need to work on solidifying their basic medical knowledge first in order to enable better diagnostic reasoning. Without basic medical knowledge, the diagnostic process is halted. Until students increase their breadth of medical knowledge, they may benefit from access to that information during diagnostic consultations in order to compensate for those knowledge gaps. Once they achieved sound knowledge, clinical experience can help them incorporate atypical symptom presentations into their repertoire, as they are exposed to real cases which can differ from the text-book cases. The present study also highlighted that students do not

receive sufficient training with regards to diseases that are uncommon in the UK. However, having to deal with patients with recent travelling history, some more knowledge of diseases that people may contract on popular travel areas could be beneficial for students.

#### ***6.3.1.4 Recommendation 4: Re-designing learning material to promote diagnostic reasoning***

The present study found that senior medical students tend to engage in a predominantly hypothesis testing approach during the diagnostic process. Expert clinicians, on the other hand, are likely to use predominantly forward reasoning at the beginning of consultations, combining information to form syndromes first, and only then proceed to hypothesis generation and testing. This approach is more efficient as it allows the narrowing down of the potential differentials from the beginning of the diagnostic process.

Based on the advancements of diagnostic reasoning research (Cooper et al., 2017), students should be discouraged from engaging in exhaustive, serial hypothesis testing, because it is an ineffective approach that is exhausting for both student and patient. Instead of eliminating differentials one by one, students may benefit from being encouraged to progressively eliminate groups of illnesses based on semantic qualifiers (Cooper et al., 2017). In order for students to move towards a more advanced level of diagnostic reasoning, they need to be taught how paraphrasing lay terms into medical ones (i.e. abstraction) not only helps precision, but it will promote better encoding and recall (Mamede et al., 2014). While it was found that the use of semantic qualifiers on their own do not lead to better diagnostic reasoning in novice medical students (Nendaz and Bordage, 2002), recent studies found that engaging in reflection and practicing abstraction by formulating problem statements can improve students' diagnostic performance (Braun et al., 2017a, Kiesewetter et al., 2013). Finally, combining descriptive statements into syndromes could help them avoid overemphasize on individual symptoms (Cooper et al., 2017).

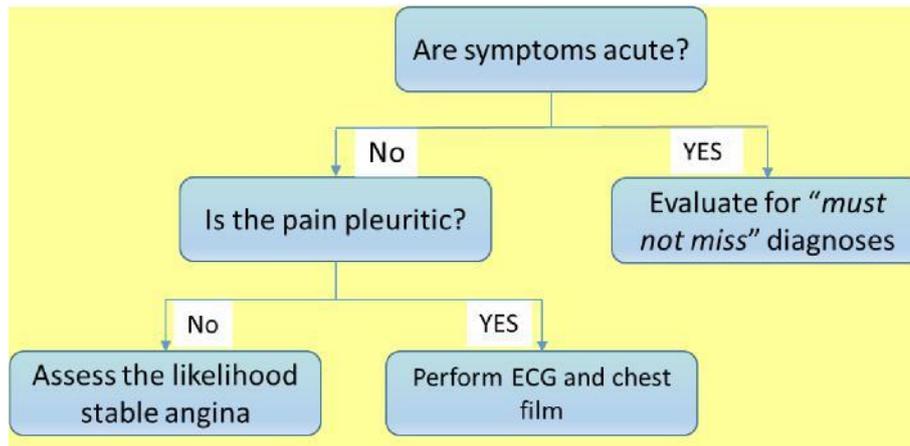
However, there are various **barriers that may prevent students from advancing towards forward reasoning**. *First*, their learning material is often organized in a way that is consistent with backward reasoning, and within that exhaustive hypothesis testing. Students often rely on symptom lists learned through a vignette form, where the diagnosis is on top, followed by the associated symptoms. Their revision notes are often

organized in a way that presents them with a generic chief complaint such as chest pain, then lists a long list of differentials that could be associated with that symptom, together with a list of symptoms that characterizes each differential. Such chief complaint-based organization is not helpful from a diagnostic reasoning perspective.

*Second*, their learning material is often organized in a way that separates diseases from each other which means students will remember those diseases separately and therefore can have difficulty when trying to connect them all across systems (de la Calzada, 2015). Instead, students may benefit from learning material that is divided based on similar syndromes, involving discriminating features. Syndromes are formed by using semantic qualifiers to define the problem statement that characterizes the patient's problems. These syndromes together with corresponding epidemiological characteristics and time course of the illness make up the illness script.

*Finally*, as previously described, students tend to rely on hybrid schemas to guide their hypothesis testing during the diagnostic process. In such an approach, they are trying to consider two or three similar diagnosis at the same time and try to discriminate between them. This is not surprising, as some of their learning material, for example the SOCRATES mnemonic, which was the most frequently mentioned memory aid during the Simulated Surgeries, is organized in such a schema. When using a hybrid schema, students would attempt to keep in mind multiple differentials and their relating characteristics at the same time. According to a recent study, instead of trying to balance information this way, students could benefit from a terminally branching approach (Blissett et al., 2017). Terminally branching schemas concentrate on one clinical feature at a time encouraging the student to take one step at a time in the diagnostic process (See *Figure 15*). It was found that terminally branching schema promoted better diagnostic performance than hybrid schema, because hybrid schema requires the learner to simultaneously keep in mind too many pieces of information which leads to a high cognitive load (Blissett et al., 2017). Terminally branching schemes on the other hand only require the learner to keep fewer pieces of information in mind, better adapted to the inherent working memory limitations of learners (Blissett et al., 2017). It is based on taking one step at a time during the diagnostic process. Adapting the students learning material to involve terminally branching schemas could therefore benefit the students and improve their diagnostic accuracy.

**Figure 15:** Terminally branching schema (Stern et al., 2015)



#### **6.3.1.5 Recommendation 5: Setting up simulated practice that facilitates diagnostic reasoning**

With increasing use of simulation in medical education, it is important that it is run in a way that optimizes gains for the learner. Simulation has been introduced to allow students to engage in the same cognitions and behaviour that would be required of them in real clinical settings, while in a safe learning environment. This way simulation can pave the way for real clinical practice. However, only with careful, deliberate planning and curriculum integration can simulation bridge the gap between the classroom and real clinical environment. The present study highlighted several issues that educators need to pay attention to when setting up simulated practice in order to encourage and facilitate diagnostic reasoning.

**First, allowing the students sufficient and flexible time for the simulated consultation is essential.** As stated before, asking senior medical students to manage diagnostic consultations within the same time frame as experts ignores the basic principles of the diagnostic expertise development. The 'OSCE effect' shows that when students are under times pressure, they cannot make the most of their analytic reasoning processes. They engage in superficial reasoning in an attempt to deal with the contextual constrains. However, when simulation is intended to help students practice diagnostic reasoning, they should not be put under such pressure. Since some students may need more time than others, and the same student may need more time for some consultations than others, allowing for flexible time for the consultations, within reasonable limits, would be most suitable. Allowing students more time could also allow them to introduce moments of silence when necessary, and engage in more active listening to the patient.

Short time limits are meant to prepare students for the time constraints of real primary care consultations. However, in real practice, general practitioners have the chance to judge whether to give an extra few minutes to one patient, or having a shorted consultation with another one, based on their individual patient needs (Carr-Hill et al., 1998). In reality, GP consultations do not always last exactly the same time (Carr-Hill et al., 1998, Britt et al., 2002). Also, during their clinical placements, final year students are given at least 20 minutes per consultation during their final year placements. Even during their foundation years, doctors are given 20-30 minutes per consultation. Considering these, the 5-10-minute stations for penultimate year students seem unrealistic, as it reflects an even stricter time limit than what is set for experienced clinicians.

*Second*, it is **important to balance the anxiety levels of the learners** (Fraser et al., 2012). Experts state that the physical and psychological arousal associated with anxiety can either facilitate or impair the learning process, depending on a dose-response relationship (Joëls et al., 2006). This phenomenon is called the *Yerkes-Dodson law* and it refers to the inverted U-shaped relationship between arousal and cognitive performance (Benson and Allen, 1980). According to this model, optimal learning takes place when the student experiences some level of arousal due to being challenged by the task at hand. On the other hand, high anxiety level can negatively affect learning, especially in those cases where the task requires higher cognitive involvement and prefrontal cortex activity (Joëls et al., 2006, pp.136). This is consistent with the students' perception, as they pointed out during the reflective interviews that in order to perform well in OSCEs they need to practice every task until they become routine, otherwise their performance struggles. By monitoring the students' lived experiences of simulated exercises, it should be determined whether the right balance of being challenged, but not overwhelmed by the task has been reached. Due to the idiosyncratic nature of perceived anxiety, providing a learning experience that is optimal for everyone is of course very difficult. However, providing safety strategies that could help students not to reach a state of panic, or to alleviate the temporary state of panic could be helpful. For example, students should be allowed to pause the simulation at any time when they feel their anxiety is preventing them from thinking clearly and ask for help.

*Third*, it is **important to manage the cognitive load of the simulated scenarios**. One factor that increased the cognitive load in the present study was the students' attempt to

recall all the various elements of the traditional history structure. The problem with the traditional consultation structure is that it tends to involve a high number of different elements. When students only have a few minutes for the whole consultations, trying to recall all these details may be especially difficult. It is important that realistic expectations are set for students and they are not encouraged to ask more questions than there could be asked within a short time frame. Due to the fact that the recall of these history elements is still effortful, having to ask a large number of standardized questions elevates the cognitive load of the consultation. One way to decrease the cognitive load would be to provide them with a prompt sheet with all the various history elements, so that they can rely on that until it becomes routine and no longer takes up large amount of cognitive resources.

Since recalling the signs and symptoms related to various differentials was also very effortful, students could also be provided access to information relating to those in order to decrease the cognitive load. This could be achieved by **allowing the students access to a computer and online resources**. Since such resources are readily available in real clinical practice, it would also elevate the fidelity of the simulation. They could use the online resources to compensate for gaps in their knowledge and thereby turn the exercise more towards the diagnostic reasoning aspect. This way the focus isn't on recalling all the checklist items, but about putting all the pieces of information together. There is also existing evidence suggesting that allowing students to practice the use of computers and online resources is important in order for them to learn how to incorporate those into the consultation (Chelton, 2009).

*Fourth, reflection and feedback should form a central part of simulated practice.*

Simulated consultations which incorporate the diagnostic reasoning element should encourage students to reflect on their reasoning process. The present study found that filming consultations and then watching the video together with the student is a great way to prompt reflections about diagnostic reasoning. This is consistent with previous findings suggesting that students find video-feedback can help actively engage students in the discussions of reasoning and communication issues (Junod Perron et al., 2016).

**Reflection, verbalizing and self-explanation were all found to facilitate the learning process** (Chamberland and Mamede, 2015). Without facilitated self-reflection, learning opportunities can be easily missed (Paige et al., 2015). **Considering the high costs of simulated practice, the potential for learning should be maximize.**

Previous research has shown that reflection in medical diagnosis could positively affect diagnostic performance, especially when reflection is used at diagnosis verification and testing initial diagnosis against evidence from the case (Mamede and Schmidt, 2017). Fourth-year students in the present study were seen at risk of anchoring bias, confirmation bias and premature closure, which shows that encouraging verification and testing of their initial diagnostic ideas could be useful for them. Therefore, providing space for reflection is important, especially at this stage of their learning. However, according to recent studies, the complexity of the task mediates the beneficial effects of reflection. The same literature review also found that reflection did not contribute much additional value in case of straightforward, routine cases (Mamede et al., 2008). Also, since reflection is dependent on existing knowledge, it is not useful when reflecting about cases that are far beyond the clinicians' expertise (Mamede and Schmidt, 2017). This highlights the importance of task complexity when designing learning exercises that utilize reflective practice – if the task is either too simple or too complicated, reflection and self-explanation won't be beneficial.

*Finally, high emphasize should also be placed on the feedback following the simulated consultations.* Based on the present findings, feedback should not be provided in checklist form, focusing solely on the questions and topics students need to cover during the consultations. Students need to shift their focus away from asking questions to concentrating on the answers. They should be explained that it is actually the reasoning and interpretation of the findings that matters the most and not sticking to set questions.

The present findings suggest that although the presence of the supervisor provides opportunity for feedback, and thereby it can be very useful, it can also increase anxiety and thereby increasing the cognitive load of the task. A possible solution could be to position the facilitator out of sight during the consultation, so that the student is encouraged to focus on the patient, instead of on being 'assessed' by the facilitator. Another solution could be removing the facilitator from the room all together. In the latter case, similarly as in the SECO clinic at Dunedin School of Medicine in New Zealand (Williamson et al., 2013), the students could be provided with the option of over-the-phone help when they feel it is necessary. The feedback from the facilitator could be replaced by self-assessment, by giving an evaluation sheet to the students after the scenario. The self-assessment this way could also facilitate metacognition skills, which would further support the students' evolving diagnostic reasoning skills

(Marcum, 2012, Kuiper and Pesut, 2004). By removing the authority figure from the simulation, the perceived need to keep talking in order to appear competent may also decrease.

### 6.3.2 Assessment of diagnostic reasoning

The present findings also have important implications for the use of assessment methods in medical education in the UK. As diagnostic reasoning is not yet systematically integrated into the undergraduate medical curriculum, it is not surprising that present assessment methods are not perfectly suited for the evaluation of these skills. Considering the importance of sound diagnostic reasoning skills for safe clinical practice, it is essential that medical graduates entering clinical practice are assessed on this skill in order to make sure they have the necessary skills to practice safely in their new role as junior doctors. Therefore, it is important to re-evaluate the assessment methods used in undergraduate medical education to understand how diagnostic reasoning assessment could be best integrated.

Epstein (2007) found that currently the most widely used assessment style in medical education involves multiple-choice questions (Epstein, 2007). These exercises work well when there is a single, right answer, however, clinical scenarios tend to involve a certain level of uncertainty and flexibility that a standard multiple-choice exercise would not be able to capture (Epstein, 2007). Also, the present findings suggest that diagnostic reasoning skills are intertwined with consultations skills. Although consultation skills and diagnostic reasoning skills are often treated as separate competencies, the present study shows that they can influence each other. Students' weakness in communication skills or interpersonal skills can influence their diagnostic process during consultations. For example, when they do not have the vocabulary to ask the right questions, or do not have the confidence to address sensitive issues, and those in turn can influence the diagnostic process by depriving them of valuable information. Therefore, diagnostic skills and consultation skills should be assessed together. However, multiple-choice questions could not realistically assess such complex skills.

On the other hand, simulated exercises are believed to provide a much more realistic venue for assessing clinical skills (Epstein, 2007, Cusimano et al., 1994). They provide opportunity to combined reasoning and consultation skills and allow for flexibility in the clinical scenarios. Standardized patient OSCEs are built on this assumption, and are designed to provide a more realistic assessment of clinical skills than other modalities could do. According to a recent report, **many medical schools in the UK consider OSCEs to be a suitable assessment form for diagnostic reasoning** (Page et al., 2016).

**However, the present findings question the assumption that standardized patient OSCEs graded with checklists are likely to tap into the diagnostic reasoning of the students.**

There are various reasons why OSCEs may not be ideal assessment for diagnostic reasoning. *First*, the same characteristic that makes OSCEs so widely used and popular – the fact they ensure objective and structured skills assessment – also make them unsuitable for testing complex clinical skills such as diagnostic reasoning. Diagnostic reasoning is unlike many clinical skills which need to be carried out in a standardized way, instead it requires some level of fluidity and flexibility. Chumley (2008) makes an excellent point of highlighting that checklists are ideal for assessing clinical skills which require the completion of several steps in the same order every time, such as various procedural skills (Chumley, 2008). However, there is no single, best way to conduct a diagnostic consultation and there is significant variability even among experts about how they would approach a consultation (Chumley, 2008, Barman, 2005). Leung (2002) also argued that reducing clinical skills to its sub-components may lead to losing something essential about the competency as a whole, implying that the competency as a whole is greater than the sum of its components (Leung, 2002).

*Second*, it has also been clear from the present findings that someone's **diagnostic reasoning process should not be assumed based on their overt behaviour**, but instead requires overt discussion. However, checklists style OSCE assessment does not provide such interaction. The present findings show that examinations that do not require the students to verbalize their thinking process should be used with caution when inferring diagnostic reasoning from the observed behaviour.

*Third*, both the present and past research findings show that **senior medical students rely heavily on analytic diagnostic reasoning strategies** to solve diagnostic problems. **Using such analytic processes is time consuming, however, the short time frame of assessments scenarios often does not take this into account.** They may explain this by claiming that the students will have to learn to do the consultations quickly. However, the emphasis should be on the future tense. Students *will* be expected to speed up the consultations in the future, once they have greater clinical experience behind them. However, during their undergraduate years when they are just piecing together history and diagnosis, this should not yet be required, especially if they are not provided with sufficient diagnostic reasoning training and guidance. Allowing students longer

time for diagnostic consultations could encourage students to engage in diagnostic reasoning instead of rushing them and thereby encouraging a reductionist, superficial approach.

*Finally*, another problem with the checklist assessment of **OSCEs that rely on generic questions is that they cannot discriminate between students with different levels of diagnostic reasoning investment** (Chumley, 2008). If the checklist requires students to ask the same set of questions for a given presenting complaint, such as chest pain, then the mere fact of asking those questions will not signify any reasoning. One student may ask those questions because they memorized the list of questions to ask every time someone presents with chest pain, while another student may ask those questions because they know that the specific presentation of the clinical symptoms justifies those questions (Chumley, 2008). In the second case the student is continuously interpreting the clinical information and applying it to the diagnostic process, while the first student is not necessarily engaging in reasoning at all. Yet they may ask the same questions and report the same diagnosis at the end of the consultation. However, without asking what is going on in their mind, it is difficult to discriminate between their diagnostic reasoning skills. Without further investigating why the student is asking those questions and how certain information influence the likelihood of the differentials, it may not be possible to tell them apart. Especially when taking into account that the students will do their best to appear competent and therefore pretend that they understand what is going on even when they really don't.

All these reasons explain why OSCEs may not be appropriate assessment strategies for diagnostic reasoning. **The present findings can also explain why previous studies found little or no correlation between OSCE scores and clinical reasoning scores** (Sim et al., 2015, Park et al., 2015, Hodges et al., 1999). However, due to the importance of diagnostic competence for safe clinical practice (Croskerry, 2009a, Durning et al., 2010c), **if OSCEs cannot suitably assess diagnostic reasoning skills, more appropriate assessment measures need to be identified**. Finding more suitable assessment style is also important because it has been established that the assessment style in education inherently influences the way students learn (Al-Kadri et al., 2012), and the present findings are consistent with this view. The gradual shift away from apprenticeship-style assessment towards a summative, tick-box style assessment may be fundamentally transforming the thinking patterns of medical students: instead of facilitating flexible, critical thinking, students are more likely to encourage limited,

reductionist thinking style. As medical schools need to accommodate an increasing number of medical students, checklist-style skill assessment may be more time and resource efficient, but it does not suit the assessment of higher cognitive skills such as diagnostic reasoning (Stalmeijer et al., 2009, Stalmeijer, 2015, Lyons et al., 2016). Therefore, in line with the *Greenaway report* (2013), the present findings encourage a move away from checklist style assessment for competencies like diagnostic reasoning towards a more flexible, interactive assessment style (Greenaway, 2013).

#### ***6.3.2.1 Recommendation 6: Introducing suitable assessment methods for diagnostic reasoning for senior medical students***

The present findings suggest that there is a need for an additional layer of assessment for diagnostic reasoning where students are explicitly asked about their reasoning process. The style of examinations is extremely important as it teaches the students what is expected of them. If they are assessed through checklists, that may encourage a tick-box attitude. If they are assessed in a flexible, interactive way, that may encourage more flexible approach. However, more flexible assessments such as traditional long case assessments, carry the risk of being subjective and have been frequently criticized for low inter-rater reliability (Ponnamperuma et al., 2009). Therefore, **an assessment tool that combines standardized and interactive elements could would be most appropriate**, such as the *Leicester assessment package (LAP)*. LAP was originally designed to assess the consultation skills of general practitioners in the UK, however, it was later adapted to use for undergraduate assessment (Braunholtz, 1995, Fraser et al., 1994). Another possibility would be to add interactive elements to the existing OSCEs, such as key feature problems or script concordance tests (Chumley, 2008, Fischer et al., 2005, Charlin et al., 2000).

While OSCEs may work very well in the early years of undergraduate training, the present findings suggest that as students approach the graduation, they perceive an increasing discrepancy between OSCE consultations and real consultations. The present study also has shown how the artificiality of the OSCE scenarios influenced the cognitions and behaviours of senior medical students. It appears that when it comes to assessments for senior medical students, even simulated scenarios fall short and do not reflect realistic performance. This finding could be linked to the *expertise reversal theory* of Kalyuga (2003), which emphasizes that instructional techniques that are highly effective for novices may be much less effective for more advanced learners (Kalyuga et al., 2003). From this study it seems that this expertise reversal theory

should also be applied to assessment strategies, whereby **assessment modalities that work well for novice students may not be appropriate for senior medical students**. If senior medical students are examined through OSCEs that involve **checklist type assessments of diagnostic consultations, that may cause students to regress to a less advanced level of diagnostic reasoning** whereby they are suppressing their attempts to reason in favour of ticking boxes. While real scenarios, in real settings with real patients are likely to prompt more patient-centred approach with more diagnostic reasoning involvement. For these reasons, **it may be beneficial to introduce a more authentic setting for assessments during the final year of undergraduate training**. Some universities already have such assessments in place for final year medical students. In Sweden, the assessment of final year medical students diagnostic skills in real, work-based clinical setting with unselected, consenting patients has already been successfully trialled and implemented (Aaraas et al., 2007). That could have the added advantage of more predictive power for future performance in the real clinical world.

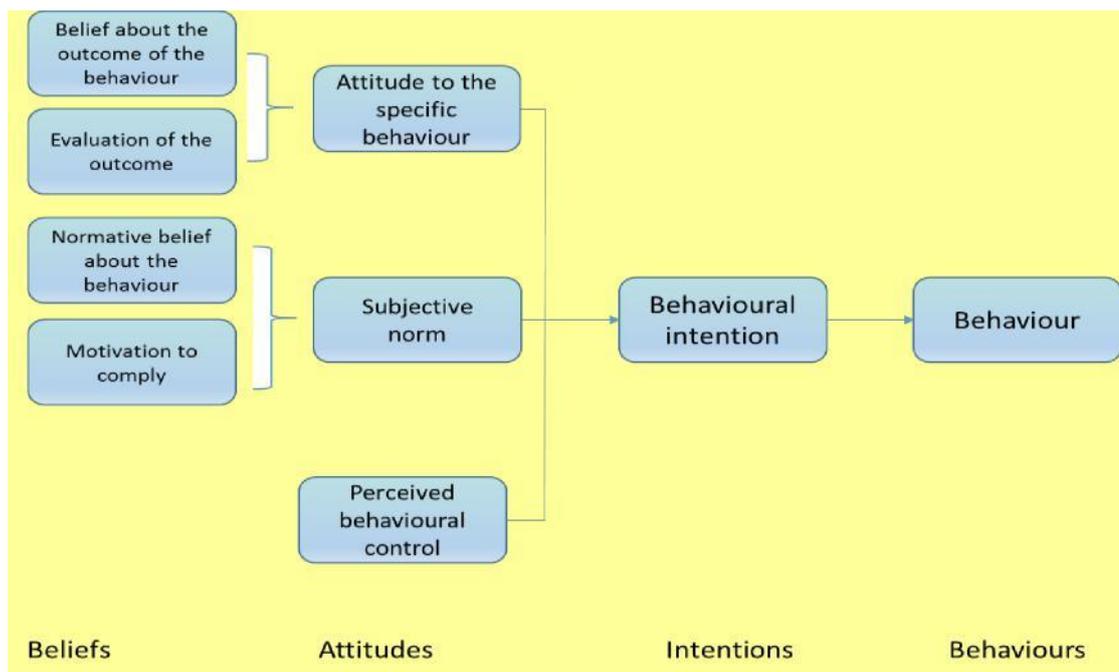
While primary care is a challenging setting for students at first, its characteristics make it ideal for both training and assessing diagnostic reasoning strategies in. This is in line with the recommendation of Page et al. (2016) who proposed that **the best route for integrating diagnostic reasoning into the curricula may be via the primary care placements** (Page et al., 2016). The primary care setting involves a broad range of conditions; relies very much on history, examinations and diagnostic reasoning; the diagnostic process involves ruling out and narrowing down differentials; and it prompts independent work which evokes a sense of professional responsibility. These features make it an ideal setting for both training and assessment purposes. Using such a generalist setting for diagnostic training would also be in line with the *Greenaway report's* recommendation for a move towards more generalist training of medical professionals (Greenaway, 2013). Even though the diagnostic process in secondary care has its own unique characteristics, medical trainees could all benefit from a basic training where they learn how to direct history taking, how to interpret clinical information in light of the working hypothesis, and how to rely on their own reasoning skills and clinical judgement in the absence of lab tests and scans. This could equip them with the basic cognitive foundations of diagnosis and management that they could utilize in the future in various clinical settings. All in all, if used together with interactive assessment style which involves asking the student to verbalize their thinking process, primary care could also be a promising speciality for assessing senior medical students' diagnostic competencies.

### 6.3.2.2 Recommendation 7: Counteracting the OSCE effect

While it has been concluded that standardized patient OSCEs with checklists style assessment is not well-suited preventing to evaluate diagnostic reasoning skills, it does not imply that OSCEs should be completely abandoned. However, it does highlight some important aspects of this examination style, which should be addressed in order to better facilitate diagnostic reasoning. There are various steps that could be taken in order to ensure that the ‘OSCE effect’ does not contaminate Simulation-Based Medical Education and instead allows students room for practicing diagnostic reasoning instead of engaging in a box ticking behaviour. These steps are explained using the cognitive framework of the ‘*theory of planned behaviour*’ (Ajzen, 1991).

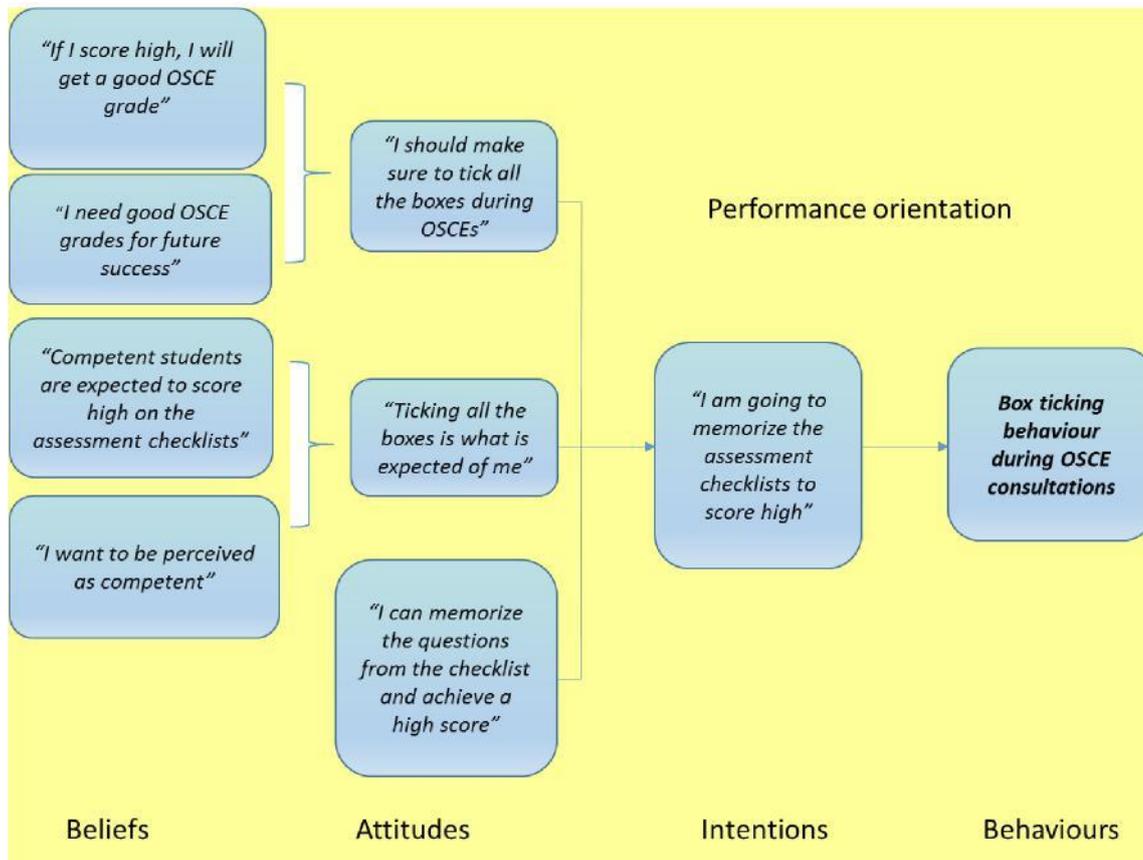
According to the *theory of planned behaviour* there are three main factors that determine one’s future behaviour: attitudes, subjective norms, and perceived control over the behaviour (See *Figure 16*) (Ajzen, 1991). These three components determine the implementation intention, which in turn will determine the behaviour itself. Attitudes are determined by beliefs about the outcome of the behaviour, and evaluation of those outcomes. Subjective norms are determined by the normative belief about the behaviour and motivation to comply. In order to achieve behaviour change, attitudes, subjective norms, and perceived control over the behaviour should be addressed.

**Figure 16:** Cognitive psychological framework for behaviour: *Theory of planned behaviour* (Ajzen, 1991)



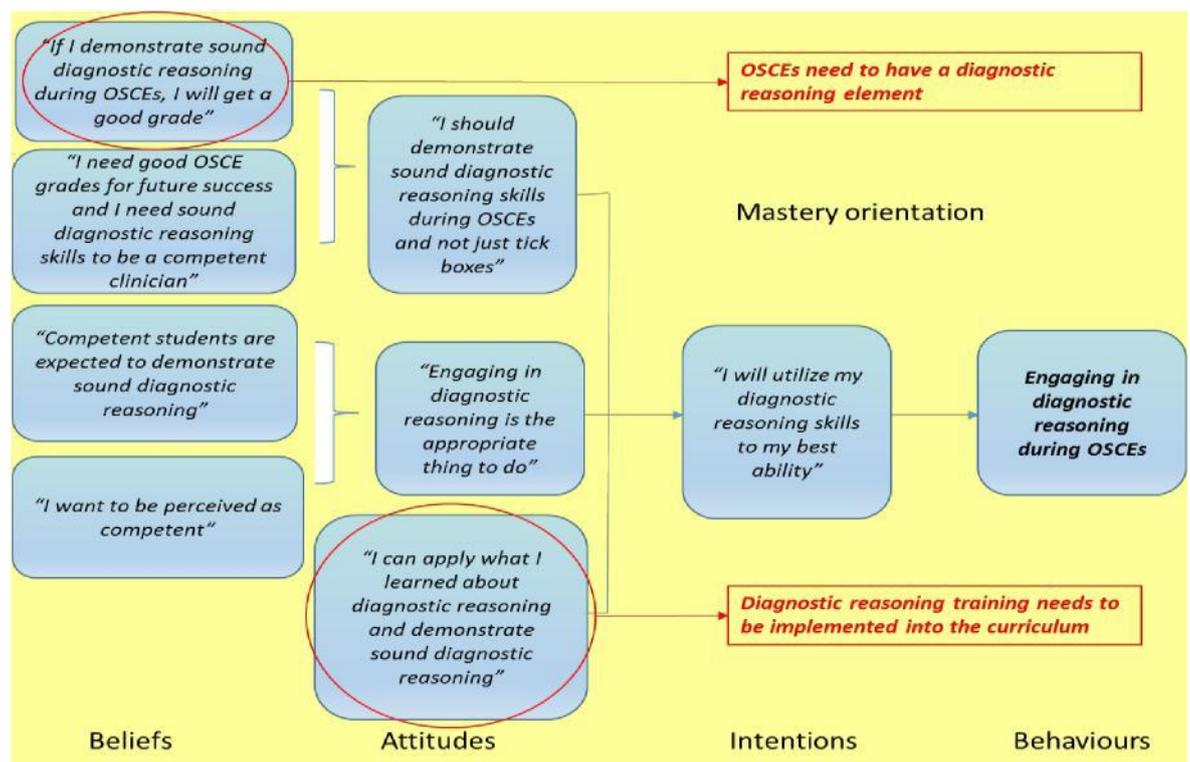
Based on the present findings, medical students in an OSCE engage in a performance driven approach (See *Figure 17*). They strive to achieve a high grade, for which they need to score as high as possible on their assessment checklist within the short time frame of OSCE stations. Engaging in analytic reasoning would be counterproductive in these situations, as there is not enough time to engage in step by step thinking, and no extra reward for engaging in a deeper level of reasoning. The nature of the assessment thereby guides students' behaviour. When applied to the 'theory of planned behaviour' model (Ajzen, 1991), this would mean that during the OSCEs, students know that achieving high scores on the assessment checklist will help them achieve a high grade. They also believe that their OSCE grades are important for their future. Therefore, they will try to make sure that they get a high score on the checklist. It is also important for the students to appear competent during these consultations and they believe they can demonstrate competence by ticking all the boxes on the assessment checklists. In order to do that, they try to memorize all the questions they are supposed to be asking for the different stations. Their planning for future behaviour is determined by these beliefs and attitudes and therefore it will result in a box ticking behaviour during OSCEs.

**Figure 17:** Performance orientation during OSCEs



According to the model, if the beliefs of the students could be changed, then the attitudes, intention and thereby the behaviour could be changed as well. It may be possible to influence the normative belief about the behaviour by changing the assessment style of the OSCEs for one that is not organized in a checklist form. Wherever there is a checklist, students will be able to memorize it and recite it back and achieve a high score without engaging in much reasoning. That is why the **assessment needs to incorporate a discussion that probes the students' real understanding of the case, instead of superficial knowledge**. If the assessment is interactive, where the students are asked about their reasoning process then that could encourage a mastery orientation for reasoning skills instead of the performance orientation of ticking boxes. In addition, students need to understand the importance of sound diagnostic reasoning skills for future clinical practice. In order to achieve a more favourable approach, **students need to change their performance orientation to mastery orientation** (See *Figure 18*). They need to receive more training in diagnostic reasoning in order to have high perceived behavioural control over their own ability to engage in diagnostic reasoning. Considering the students desire to move away from the checklist attitude when they enter real clinical practice, these changes could help them facilitate their transition from medical school into the real clinical world.

**Figure 18: Mastery orientation during OSCEs**



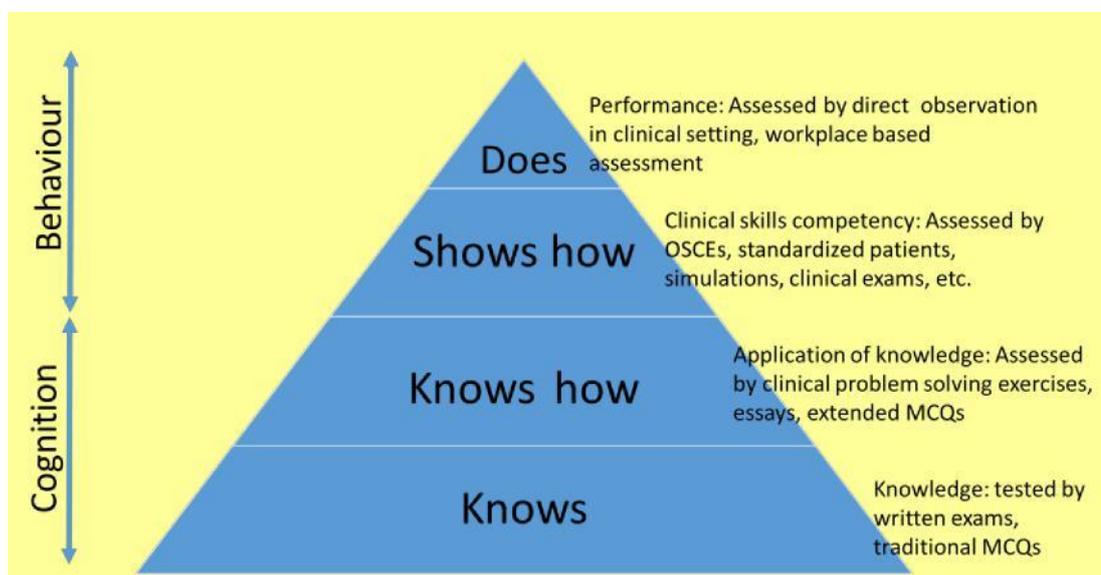
## 6.4 THEORETICAL IMPLICATIONS

The findings of the present study also have important theoretical implications. The findings suggest that it is important to revise the conceptual framework used to assess clinical competencies in medical education by incorporating the importance of diagnostic reasoning could contribute for better assessment for diagnostic reasoning skills in medical education.

### 6.4.1 Clinical competency assessment in medical education – revising the Miller pyramid

The Miller pyramid (1990) was designed to provide a conceptual framework for assessing clinical competencies in medical education (See Chapter 1). The pyramid is made up of four tiers, labelled ‘knows’, ‘knows how’, ‘shows’ and ‘shows how’. While the lower two levels are associated with cognitive skills, the upper two skills are associated with behaviours, as seen in *Figure 19*. This framework suggests that the highest level of competence is achieved when the student is able to perform the clinical skills in the real clinical environment.

*Figure 19: The cognitive and behavioural elements of Miller’s pyramid (Miller, 1990)*

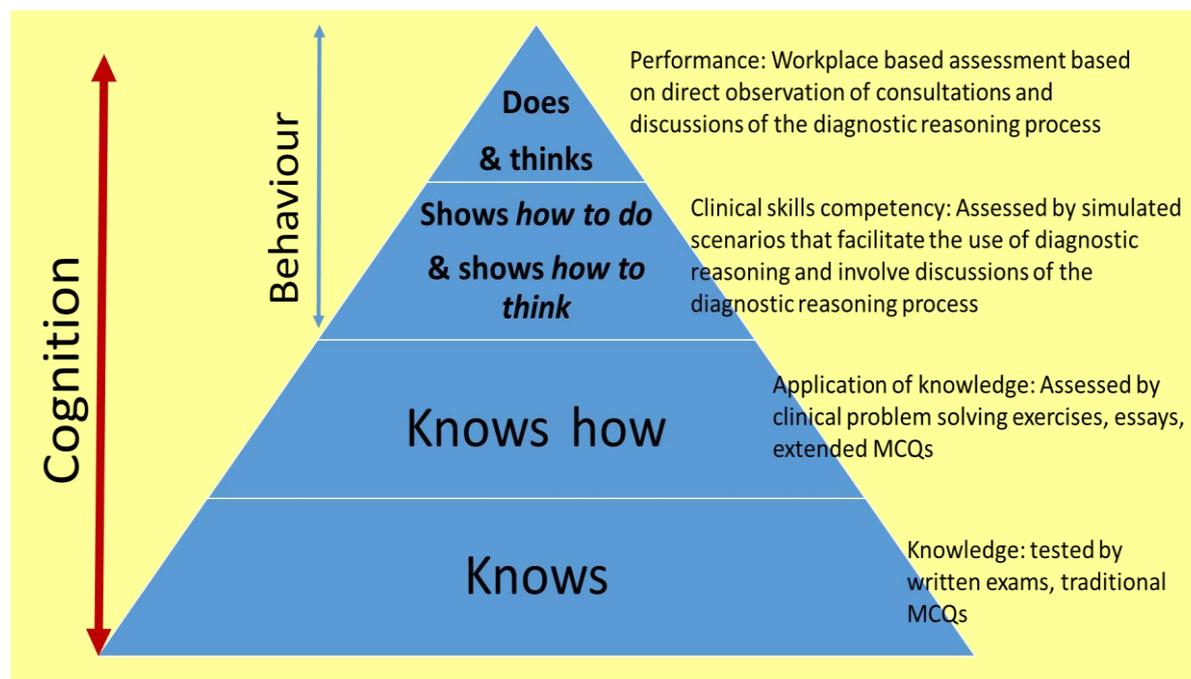


As concluded in the present paper, **OSCEs do not seem to successfully assess the diagnostic reasoning of medical students. However, according to the Miller pyramid, OSCEs were never intended to do that in the first place.** According to the Miller’s pyramid, OSCEs are supposed to assess behaviours and not cognitions. So why do medical schools think it could assess diagnostic reasoning? The answer to this

question may be twofold. First, diagnostic reasoning is a relatively new educational target and therefore there are no agreed upon protocols for either its training or its assessment. Therefore, in the absence of a more suitable assessment, it is often tagged onto an already existing one. The recent increase in the awareness of the importance of this skill and the consequent pressure to integrate it into the curriculum may have prompted medical schools to simply add it onto the list of competencies OSCEs assess. Second, OSCEs are successful in assessing various clinical skills (Berendonk et al., 2013, Swanson and van der Vleuten, 2013), therefore, it seems natural that it could also accommodate another clinical skill, such as diagnostic reasoning. However, there is a fundamental problem with this assumption. OSCEs are predominantly designed to assess observable behaviours, not cognitions. Cognitive skills such as reasoning are inherently covert, and the only way to assess them during OSCEs is to infer them from the students' observable behaviour. However, as shown by the present research there can be great discrepancy between what students think and what they say out loud. Therefore, inferring reasoning from verbal behaviour does not seem reliable.

However, the finding that OSCEs in their standard form are not suitable for assessing diagnostic reasoning should not mean that it should not be assessed at all. On the contrary, it is an essential clinical skill that should occupy a significant position in the medical curriculum. This also means that **the cognitive element of the Miller pyramid needs to rise above the lower two tiers of the pyramid** (See *Figure 20*). While the competencies of '*knowing*' and '*knowing how*' on the bottom two tiers are essential for assessing medical knowledge, the cognitive element should not stop there. The top tiers should include '*show how to think*' and '*think*' in addition to the behavioural components. These two modifications should encompass the assessment of diagnostic reasoning first in simulated, then in real, clinical setting. **Revising the Miller pyramid by enhancing the cognitive element could be the first step towards a curriculum that values the importance of diagnostic reasoning.**

**Figure 20:** The revised 'Miller's pyramid' for clinical competency assessment that incorporates diagnostic reasoning



## 6.5 LIMITATIONS OF FINDINGS

Whilst much of the present findings are consistent with existing findings which provides an added level of validation for the results, there were also some limitations that need to be discussed.

- (1) Due to the OSCE-like setting of the Simulated Surgeries, it was difficult to disentangle which cognitions and behaviours of the students were realistic and which ones were determined by the OSCE elements. Therefore, there is a possibility that there was some interference from the OSCE nature of the setting to the inferences that could be drawn about fourth year students' diagnostic reasoning. However, in order to minimize this interference, the analysis was carefully rooted in the empirical data, taking into consideration the participants interpretations of their own cognitions and behaviours. However, there may be a possibility that the students' cognitions were influenced in ways which they were not consciously aware of, which is an inherent limitation of introspection. Willing (2001) refers to these as non-propositional, pre-cognitive knowledge (Willig, 2001). However, the researcher's secondary interpretation of the students' experiences supplemented the analysis by highlighting where such pre-conscious influences may have played a part.
- (2) While coming across the 'OSCE effect' was an interesting and informative finding, which has important implications for medical education, it was not the primary aim of the study. The original aim of the study was to investigate medical students in a setting that resembles real primary care environment, rather than an examination setting. In order for the study to avoid this unintended OSCE effects, instead of making use of the existing Simulated Surgeries, separate simulated consultations could have been set up. That way it could have been ensured that the simulation does not involve an assessment element directing the students' attention away from the diagnostic task at hand.
- (3) A further limitation of the present study was the low participant number of Phase 2 and 3. This was mainly due to the timing issues caused by acquiring all necessary ethical approvals prior to the study, which has taken longer than anticipated. This difficulty could have been overcome, if all ethical approvals together with applications for research passport involving the DBS check and occupational health check have been attained at the beginning of the project. If these approvals could

have been acquired earlier, then the participant recruitment and data collection phase could have been longer, which would have provided time for involving a larger participant sample in phase 2 and 3.

- (4) The difference in the participants' roles throughout the various phases of the study may have also acted as a confounding factor. In phase 1, students perceived the simulated consultations primarily as formative OSCE exercises that could help them pass their future assessments. They were consciously aware of the fact that they were consulting with actors, not real patients, and their behaviour did not necessarily reflect their approach to real consultations. In phase 2, students were working with real patients, without direct observation from a supervisor, which had a significant effect on their consultations. They had more responsibility and were no longer asking questions to tick boxes. However, their engagement with the patients was limited due to the short duration of their placement and the fact that they were not yet allowed to make autonomous decisions. Finally, in phase 3, the junior doctors were completing long placements, able to see the same patients repeatedly, making use of the continuity of care model of primary care for both the diagnostic process and to follow up on management plans. While they were still under supervision, they had much more responsibility and autonomy in their clinical decisions. These differences may have had a strong influence on the participants' approach to the consultations, which could have influenced the observed differences between the three year groups.
- (5) Due to the design of the present study, drawing conclusions about the developmental trajectory of diagnostic reasoning skills is problematic. While the fourth year and final year students belonged to the same cohort of the same medical school, the foundation doctors were, for practical reasons, drawn from a single, different medical school. Therefore, it cannot be concluded from the findings *how* medical students' skills change over the years and across the graduation. The conclusions drawn focus on what characterizes participants in the various year groups when comparing and contrasting their interview data.
- (6) Another limitation of the study was that the findings may be specific to the curriculum of the local medical school. OSCE procedures, primary care training, and diagnostic reasoning training may all be significantly different in various medical schools, which would limit the transferability of the findings. Other

medical schools may use different style rating and assessments during OSCEs, such as domain scoring or global scores instead of checklists. The present findings would only be transferable to medical schools using checklist style OSCE assessment. Medical schools may also differ on how much time students spend in primary care placements and at what part of the curriculum they are first given the responsibility of diagnosing and managing patients. Furthermore, as diagnostic reasoning is not part of the core curriculum, different medical schools are also likely to involve different diagnostic reasoning training in their curriculum, which may further limit the transferability of the present findings. In order to facilitate transferability, both the curriculum design and OSCE procedures of the local medical school have been described in detail.

- (7) In the practical implications of this study, the main focus is on helping students to improve their analytic reasoning strategies. However, this should not be understood as downplaying the importance of non-analytic reasoning strategies. On the contrary, the suggestions made for curriculum development could help students move towards developing illness scripts which are the basis for expert diagnostic reasoning (Schmidt et al., 1990, Norman, 2005b, Elstein and Schwartz, 2002). Research shows that students who are encouraged to use both their analytic and non-analytic strategies to solve diagnostic problems tend to achieve higher diagnostic accuracy than those who are only making use of one of those (Eva, 2005). Therefore, while it is important for students to develop sound analytic reasoning skills, they should also be encouraged to make use of their non-analytic strategies.
- (8) Voluntary participation may have biased the results, as students who volunteered may have been more confident in their skills than others. Unfortunately, many of the participants did not consent to accessing their academic results, therefore it is not possible to objectively determine whether this assumption was correct. Participants may have been students who are naturally more reflective and interested in diagnostic reasoning. If this is the case, then the conclusions may overestimate the diagnostic ability of the rest of the cohort. However, if it is in fact correct that the participants were from the stronger academic background, than those educational needs may be even stronger for the whole population of students, and therefore the practical recommendations would benefit the cohort. Future studies could be directed towards collecting more demographic information about

the participants in order to investigate whether those characteristics influence their diagnostic reasoning skills.

- (9) The present study only touched upon a small number of the extrinsic and intrinsic factors implicated in the existing models of diagnostic reasoning. According to a model proposed by Durning and colleagues (2011), there are three types of factors influencing diagnostic reasoning, which include the followings: (1) *doctor factors*, such as expertise, intelligence, self-regulation, deliberate practice, sleepiness, well-being, mental illness; (2) *patient factors*, such as acuity of illness, spoken English, proficiency etc.; and (3) *encounter factors* such as common/atypical presentation, appointment length, setting etc. (Durning et al., 2011). The present study mainly explored encounter factors, as those were the ones participants focused on.

However, it does not mean that other factors have not played a role in the background. Therefore, it is not suggested that the present study provides a fully comprehensive account of diagnostic reasoning. On the other hand, it did explore every aspect that the students found important or salient enough to mention during their reflections.

- (10) Finally, there are some inherent limitations associated with the use of IPA methodology. There is a general view that qualitative studies with small participant numbers cannot be used for generalizing the findings. However, random and large samples are not always required for the contribution of knowledge. Formal, statistical generalization based on large samples is not the only source of scientific progress. A single case study can be critical in the development of new theories or the revision of existing ones. Qualitative studies with small sample size are ideal to explore in detail the lived experiences of the participants. The aim is to identify details that have not been included in previous theoretical models, and by that enhance the understanding of the phenomenon in question. It can also identify factors that explain some of the discrepancies found in previous data. Its distinct advantage over quantitative methods is the ability to focus on the details in a way that would not be possible when using a large sample size. Furthermore, a single case study can be used to falsify previously accepted models or assumptions. The in-depth approach of qualitative studies is ideal for identifying “black swans” – to reveal that what has appeared to be white from the distance may actually be black from close up (Flyvbjerg, 2006). In the present study, falsifying the assumption that OSCEs, or simulations that share certain contextual characteristics with OSCEs

could realistically evaluate diagnostic reasoning. Although IPA data may not be ideal for formal generalization, the findings can be analysed and interpreted in light with existing theories in order to generate new models and theories. In the present study it involves the 'OSCE effect' model and the identification of the window of opportunity in the undergraduate curriculum for the integration of diagnostic reasoning training.

Others argue that it is the transferability of the findings that should be considered in case of qualitative studies instead of generalizability. Transferability is determined by the readers of the study who are invited to make connections between the findings of the present study and their own experiences. Due to the great divergence in curriculum content and structure across various medical school in the UK, it is yet to be explored whether the present findings hold true across various settings. Diagnostic reasoning is generally largely part of the hidden curriculum and hence not greatly controlled or standardized across schools. Therefore, students from other medical schools which offer a significantly different diagnostic skills training may have different levels of competencies as the medical students participating in the present study. However, the survey results provide some confirmation that students across the UK share similar experiences to what is termed "OSCE effect" here.

The subjectivity of interpretations may also raise questions of validity (Golsworthy and Coyle, 2001). On the one hand, Francis Bacon expressed that it is part of human nature to overstate the degree of order and equality in things; a problem all researchers have to face (Bacon, 1620). As IPA allows more room for interpretation and judgement than other research methods, it is often seen as less rigorous than those methods. However, according to researchers, in-depth, qualitative studies tend to report that their original assumptions and preconceived ideas has been incorrect, which has led them to revise their hypothesis (Flyvbjerg, 2006). It is falsification and not verification that characterizes such studies (Flyvbjerg, 2006).

Some researchers opt to validate their interpretations by other academics and researchers (Duncan et al., 2001, Smith et al., 2002), while other simply claim that reliability is an inappropriate criterion to use for IPA studies (Yardley, 2000). In the present study, the interpretations were checked by two academics in addition to the researcher in order to ensure the credibility of the findings, to ensure that the

interpretations remained grounded in the empirical data, and to ensure that the data was sufficiently contextualised; but not to serve as a ‘check of objectivity’ (Osborn and Smith, 1998). As the present paper aims to offer one of the many possible interpretations of the data, it does not intend to claim “the singular true account” (Yardley, 2000, Brocki and Wearden, 2006).

## 6.6 FUTURE DIRECTIONS

There are various ways in which the present study has paved the way for future research.

**First**, the IPA study of fourth year medicals students could be repeated in various medical schools. The use of the present methodology has distinct advantages, as it allows for the consideration of contextual factors and is enriched by the students' own interpretations of the diagnostic process. Repeating the study in further settings could allow for testing the transferability of the findings. It may be that students in other medical school are at different stage in their diagnostic reasoning development due to different curriculum structure and different diagnostic reasoning training. Further research in this area could help illuminate these.

**Second**, research could progress towards looking at the next developmental stage, the diagnostic reasoning skills of GP trainees. Such research could contribute towards the development of a developmental model for diagnostic reasoning skills across the continuum of medical education.

**Third**, future research could be built on the practical implications of the present findings. New diagnostic reasoning modules could be implemented in order to facilitate the diagnostic reasoning development of senior medical students at the local medical school. The implementation of such training should be accompanied by the monitoring of the effectiveness of such training.

**Fourth**, simulated practices which resemble examination settings could be re-designed in a more diagnostic reasoning friendly way.

**Fifth**, experimental studies could be used to test the various elements of the 'OSCE effect' model.

**Finally**, IPA studies could be conducted in real OSCE setting in order to reveal the students lived experiences during actual OSCE consultations in even more detail.

## 6.7 CONCLUDING REMARKS

According to Lukacs (2009), when talking about original contribution to knowledge, "original" means *"the potential to do at least one of the following: uncover new facts or principles, suggest relationships that were previously unrecognized, challenge existing truths or assumptions, afford new insights into little-understood phenomena, or suggest new interpretations of known facts that can alter man's perception of the world around him"*(Lukacs, 2009). The present study successfully achieved more than one of the above criteria. It is the first qualitative study to explore senior medical students' experiences of diagnostic consultations in a practice OSCE setting. It is also the first qualitative study to explore final year medical students' and Foundation trainees' experiences in a primary care setting. The study helped to illuminate how medical students perceive, understand and interpret the diagnostic process in primary care. It has also explored their perceptions and experiences of OSCEs in relation to diagnostic reasoning. The study successfully contributed to the understanding of medical students' diagnostic reasoning development. It added to the existing research by suggesting new interpretations for previous findings, and it provided useful insight into medical students' experiences which had both practical and theoretical implications for undergraduate medical education.

The most important original contributions of the present study are the followings:

- i. Identifying the 'OSCE effect', which could provide new insight into why previous quantitative studies have not found a correlation between OSCE scores and diagnostic reasoning performance
- ii. Proposing ways to counteract the 'OSCE effect' by applying the present findings to the 'theory of planned behaviour'
- iii. Identifying simulation features that need to be addressed in order to facilitate diagnostic reasoning
- iv. Challenging the assumption that standardized patient OSCEs with checklist style assessment could successfully evaluate diagnostic reasoning skills
- v. Identifying a suitable window of opportunity for diagnostic reasoning training to be integrated into the medical curriculum based on empirical data
- vi. Calling attention to the importance of facilitating students' transition between history taking and diagnosis
- vii. Proposing the revision of the Miller pyramid in order to emphasize the importance of the cognitive elements in clinical competence.

## 7 REFERENCES

- ABDULGHANI, H. M., ALKANHAL, A. A., MAHMOUD, E. S., PONNAMPERUMA, G. G. & ALFARIS, E. A. 2011. Stress and Its Effects on Medical Students: A Cross-sectional Study at a College of Medicine in Saudi Arabia. *Journal of Health, Population, and Nutrition*, 29, 516-22.
- AFFERBACH, P. & JOHNSTON, P. 1984. On the use of verbal reports in reading research. *Journal of Reading Behavior*, 16, 307-322.
- AJJAWI, R. & HIGGS, J. 2008. Learning to Reason: A Journey of Professional Socialisation. *Advances in Health Sciences Education*, 13, 133-150.
- AJZEN, I. 1991. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.
- AL-KADRI, H. M., AL-MOAMARY, M. S., ROBERTS, C. & VAN DER VLEUTEN, C. P. 2012. Exploring assessment factors contributing to students' study strategies: literature review. *Medical Teacher*, 34 Suppl 1, S42-50.
- ALRAWAHI, Z. & ALSHIDHANI, S. 2002. The Usability of the Virtual Hospital Round. In: M. Driscoll & T. Reeves (Eds.), *Proceedings of E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2002* (pp. 91-97). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).
- APER, L., VELDHUIJZEN, W., DORNAN, T., VAN DE RIDDER, M., KOOLE, S., DERESE, A. & RENIERS, J. 2015. "Should I prioritize medical problem solving or attentive listening?": the dilemmas and challenges that medical students experience when learning to conduct consultations. *Patient Education and Counseling*, 98, 77-84.
- AROCHA, J. F., PATEL, V. L. & PATEL, Y. C. 1993. Hypothesis generation and the coordination of theory and evidence in novice diagnostic reasoning. *Medical Decision Making*, 13, 198-211.
- AROCHA, J. F., WANG, D. & PATEL, V. L. 2005. Identifying reasoning strategies in medical decision making: a methodological guide. *Journal of Biomedical Informatics*, 38, 154-71.
- ARONSON, J. 1994. A pragmatic view of thematic analysis. *The Qualitative Report*, 2, 1-3.
- ATTRIDE-STIRLING, J. 2001. Thematic networks: an analytic tool for qualitative research. *Qualitative Research*, 1, 385-405.
- BACON, F. 1620. *Novum organum*. In: BACON, F. (ed.) (1952.) *Advancement of learning, Novum Organum, New Atlantis*. Chicago: Encyclopaedia Britannica.
- BALLA, J., HENEGHAN, C., GOYDER, C. & THOMPSON, M. 2012. Identifying early warning signs for diagnostic errors in primary care: a qualitative study. *BMJ Open*, 2.
- BANNON, M. 2006. What's happening in postgraduate medical education? *Archives of Disease in Childhood*, 91, 68-70.
- BARBEY, A. K. & SLOMAN, S. A. 2007. Base-rate respect: From ecological rationality to dual processes. *Behavioral and Brain Sciences*, 30, 241-254.
- BARMAN, A. 2005. Critiques on the Objective Structured Clinical Examination. *Annals of the Academy of Medicine, Singapore*, 34, 478-82.
- BARROWS, H. S., NORMAN, G. R., NEUFELD, V. R. & FEIGHTNER, J. W. 1982. The clinical reasoning of randomly selected physicians in general medical practice. *Clinical and Investigative Medicine*, 5, 49-55.
- BECK, U. 1992. *Risk Society: Towards a New Modernity*, London, Sage.
- BECKETT, M., HULBERT, D. & BROWN, R. 2006. The new consultant survey 2005. *Emergency Medicine Journal*, 23, 461-3.
- BEISECKER, A. E., MURDEN, R. A., MOORE, W. P., GRAHAM, D. & NELMIG, L. 1996. Attitudes of medical students and primary care physicians regarding input of older and younger patients in medical decisions. *Medical Care*, 34, 126-37.

- BENNER, P. 1984. *From novice to expert: Excellence and power in clinical nursing practice*. Reading, MA: Addison-Wesley.
- BENSON, H. & ALLEN, R. L. 1980. How much stress is too much? *Harvard Business Review*, 58, 86-92.
- BERENDONK, C., STALMEIJER, R. E. & SCHUWIRTH, L. W. 2013. Expertise in performance assessment: assessors' perspectives. *Advances in Health Sciences Education: Theory and Practice*, 18, 559-71.
- BERGENE, A. 2007. Towards A Critical Realist Comparative Methodology: context-sensitive theoretical comparison. *Journal of Critical Realism*, 6, 5-27.
- BHASKAR & R. 1975. *A Realist Theory of Science*, Leeds, UK, Leeds Books.
- BHASKAR & R. 1978. *The Possibility of Naturalism*. Sussex, UK: Harvester Press.
- BHASKAR & R. 1989. *Reclaiming reality*. London: Verso.
- BHASKAR & R. 1998. Philosophy and Scientific Realism. In: ARCHER, M., BHASKAR, R., COLLIER, A., LAWSON, T., NORRIE, A. (ed.) *Critical Realism: Essential Readings*. London: Routledge.
- BHASKAR, R. 1978. *The Possibility of Naturalism*. Sussex, UK: Harvester Press.
- BLISSETT, S., MORRISON, D., MCCARTY, D. & SIBBALD, M. 2017. Should learners reason one step at a time? A randomised trial of two diagnostic scheme designs. *Medical Education*, 51, 432-441.
- BLOOM, B. S. 1954. The thought process of students in discussion. In: FRENCH, S. J. (ed.) *Accent on teaching: Experiments in general education*. New York: Harper & Row.
- BOGG, J., GIBBS, T. & BUNDRED, P. 2001. Training, job demands and mental health of pre-registration house officers. *Medical Education*, 35, 590-595.
- BORDAGE, G. 2007a. Moving the field forward: going beyond quantitative-qualitative. *Academic Medicine*, 82, S126-8.
- BORDAGE, G. 2007b. Prototypes and semantic qualifiers: from past to present. *Medical Education*, 41, 1117-21.
- BORDAGE, G., GRANT, J. & MARSDEN, P. 1990. Quantitative assessment of diagnostic ability. *Medical Education*, 24, 413-425.
- BORGES, N. J., MANUEL, R. S., ELAM, C. L. & JONES, B. J. 2010. Differences in motives between Millennial and Generation X medical students. *Medical Education*, 44, 570-6.
- BORNSTEIN, B. H., EMLER, A. C. & CHAPMAN, G. B. 1999. Rationality in medical treatment decisions: is there a sunk-cost effect? *Social Science and Medicine*, 49, 215-22.
- BOSHUIZEN, H., BROMME, R. & GRUBER, H. 2004. *Professional Learning: Gaps and Transitions on the Way from Novice to Expert*. Springer Netherlands.
- BOWEN, J. L. 2006. Educational strategies to promote clinical diagnostic reasoning. *The New England Journal of Medicine*, 355, 2217-25.
- BOYATZIS, R. E. 1998. *Transforming qualitative information: thematic analysis and code development*, Thousand Oaks, Thousand Oaks: Sage.
- BRADLEY, P. 2006. The history of simulation in medical education and possible future directions. *Medical Education*, 40, 254-262.
- BRANCH, J. L. 2000. Investigating the Information- Seeking Processes of Adolescents: The Value of Using Think Alouds and Think Afters. *Library and Information Science Research*, 22, 371-392.
- BRAUN, L. T., ZOTTMANN, J. M., ADOLF, C., LOTTSPEICH, C., THEN, C., WIRTH, S., FISCHER, M. R. & SCHMIDMAIER, R. 2017a. Representation scaffolds improve diagnostic efficiency in medical students. *Medical Education*, 51, 1118-1126.
- BRAUN, L. T., ZWAAN, L., KIESEWETTER, J., FISCHER, M. R. & SCHMIDMAIER, R. 2017b. Diagnostic errors by medical students: results of a prospective qualitative study. *BMC Medical Education*, 17, 191.
- BRAUN, V. & CLARKE, V. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77-101.
- BRAUN, V. & CLARKE, V. 2014. What can "thematic analysis" offer health and wellbeing researchers? *International Journal of Qualitative Studies on Health and Well-being*, 9, 26152.
- BRAUNHOLTZ, D. 1995. Leicester assessment package. *The British Journal of General Practice*, 45, 51-2.

- BREDO, E. 1994. Reconstructing educational psychology: Situated cognition and Deweyian pragmatism. *Educational Psychologist*, 29, 23-35.
- BRITT, H., VALENTI, L. & MILLER, G. 2002. Time for care. Length of general practice consultations in Australia. *Australian Family Physician*, 31, 876-80.
- BROCKI, J. M. & WEARDEN, A. J. 2006. A critical evaluation of the use of interpretative phenomenological analysis (IPA) in health psychology. *Psychology & Health*, 21, 871-80.
- BRYMAN, A. 2004. Qualitative research on leadership: A critical but appreciative review. *The Leadership Quarterly*, 15, 729-769.
- BRYMAN, A. & BELL, E. 2003. *Business Research Methods*. New York: Oxford University Press.
- BUCKLEY, G. 1998. Partial truths--research papers in medical education. *Medical Education*, 32, 1-2.
- CARLSON, J. & DACHS, R. J. 2015. Family medicine residents remain unaware of hospital charges for diagnostic testing. *Family Medicine*, 47, 466-9.
- CARR-HILL, R., JENKINS-CLARKE, S., DIXON, P. & PRINGLE, M. 1998. Do minutes count? Consultation lengths in general practice. *Journal of Health Services Research and Policy*, 3, 207-13.
- CAVE, J., GOLDACRE, M., LAMBERT, T., WOOLF, K., JONES, A. & DACRE, J. 2007. Newly qualified doctors' views about whether their medical school had trained them well: questionnaire surveys. *BMC Medical Education*, 7, 38.
- CHAMBERLAND, M. & MAMEDE, S. 2015. Self-Explanation, An Instructional Strategy to Foster Clinical Reasoning in Medical Students. *Health Professions Education*, 1, 24-33.
- CHAN, G. K., BRYKCYNSKI, K., MALONE, R. E. & BENNER, P. 2010. *Interpretive Phenomenology in Health Care Research* [Online]. Indianapolis, IN, United States: SIGMA Theta Tau International, Center for Nursing Press.
- CHAPMAN, R., WYNTER, L., BURGESS, A. & MELLIS, C. 2014. Can we improve the delivery of bedside teaching? *Clinical Teacher*, 11, 467-471.
- CHARLIN, B., ROY, L., BRAILOVSKY, C., GOULET, F. & VAN DER VLEUTEN, C. 2000. The Script Concordance test: a tool to assess the reflective clinician. *Teaching and Learning in Medicine*, 12, 189-195.
- CHAVEZ, L. R., HUBBELL, F. A., MCMULLIN, J. M., MARTINEZ, R. G. & MISHRA, S. I. 1995. Structure and meaning in models of breast and cervical cancer risk factors: a comparison of perceptions among Latinas, Anglo women, and physicians. *Medical Anthropology Quarterly*, 9, 40-74.
- CHELTON, B.S. 2009. *A Qualitative Study to Evaluate the Effectiveness of Simulation as a Training Method in Implementation of Electronic Medical Records*. Doctoral Dissertation, Medical University of South Carolina - College of Health Professions.
- CHESSARE, J. B. 1998. Teaching clinical decision-making to pediatric residents in an era of managed care. *Pediatrics*, 101, 762-767.
- CHUDERSKI, A. 2015. The broad factor of working memory is virtually isomorphic to fluid intelligence tested under time pressure. *Personality and Individual Differences*, 85, 981-990.
- CHUDERSKI, A. & NECKA, E. 2012. The Contribution of Working Memory to Fluid Reasoning: Capacity, Control, or Both? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 38, 1689-1710.
- CHUMLEY, H. S. 2008. What does an OSCE checklist measure? *Family Medicine*, 40, 589-91.
- CLARKE, V. & BRAUN, V. 2013. Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning. *The Psychologist*, 26, 120-123.
- CLEGG, F. 1998. *Simple Statistics: A course book for Social Scientists*. Cambridge: Cambridge University Press.
- CLELAND, J. A. & DURNING, S. J. 2015. *Researching medical education*. Chichester, West Sussex: John Wiley and Sons, Inc.
- CODERRE, S., MANDIN, H., HARASYM, P. H. & FICK, G. H. 2003. Diagnostic reasoning strategies and diagnostic success. *Medical Education*, 37, 695-703.
- COHEN, L., MORRISON, K. & MANION, L. 2002. *Research Methods in Education*, London, Routledge.

- COLLINS, K. M. T., ONWUEGBUZIE, A. J. & JIAO, Q. G. 2007. A mixed methods investigation of mixed methods sampling designs in social and health science research. *Journal of Mixed Methods Research*, 1, 267-294.
- COOK, D. A. & TRIOLA, M. M. 2009. Virtual patients: a critical literature review and proposed next steps. *Medical Education*, 43, 303-311.
- COOPER, N., DA SILVA, A. S. & POWELL, S. 2017. Teaching Clinical Reasoning. In: COOPER, N. & FRAIN, J. (eds.) *ABC of Clinical Reasoning*. London: Willey & Sons.
- CORBIN, J. M. 2008. *Basics of qualitative research: techniques and procedures for developing grounded theory*, Los Angeles, Calif: Sage Publications, Inc.
- CORBO, M., PATEL, J. P., ABDEL TAWAB, R. & DAVIES, J. G. 2006. Evaluating clinical skills of undergraduate pharmacy students using objective structured clinical examinations (OSCEs). *Pharmacy Education*, 6, 53-58.
- COWAN, N. 2001. The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral and Brain Sciences*, 24, 87-114.
- CRAIG, J. L. 1992. Retention of interviewing skills learned by first-year medical students: a longitudinal study. *Medical Education*, 26, 276-81.
- CRESWELL, J. W., FETTERS, M. D. & IVANKOVA, N. V. 2004. Designing A Mixed Methods Study In Primary Care. *Annals of Family Medicine*.
- CROSKERRY, P. 2002. Achieving quality in clinical decision making: cognitive strategies and detection of bias. *Academic Emergency Medicine*, 9, 1184-204.
- CROSKERRY, P. 2009a. A universal model of diagnostic reasoning. *Academic Medicine*, 84, 1022-8.
- CROSKERRY, P. 2009b. Clinical Cognition and Diagnostic Error: Applications of a Dual Process Model of Reasoning. *Advances in Health Sciences Education*, 14, 27-35.
- CROSKERRY, P. 2009c. Context is everything or how could I have been that stupid? *Healthcare Quarterly*, 12, e171-6.
- CUSIMANO, M. D., COHEN, R., TUCKER, W., MURNAGHAN, J., KODAMA, R. & REZNICK, R. 1994. A comparative analysis of the costs of administration of an OSCE (objective structured clinical examination). *Academic Medicine*, 69, 571-6.
- CUTHBERT, L. G., DUBOULAY, B., TEATHER, D., TEATHER, B., SHARPLES, M. & DUBOULAY, G. H. 1999. *Expert/Novice differences in Diagnostic Medical Cognition: A Review of the Literature*. University of Sussex.
- DANERMARK, B., M., E., L., J. & J.C, K. 2002. *Explaining Society: Critical Realism in the Social Sciences*. London: Routledge.
- DANIEL-UNDERWOOD, L. 2016. *Using high-fidelity medical simulation to assess critical thinking in medical students*. Doctor of Philosophy, Andrews University.
- DAVIS, D. A., NORMAN, G. R., PAINVIN, A., LINDSAY, E., RAGBEER, M. S. & RATH, D. 1990. Attempting to ensure physician competence. *Jama*, 263, 2041-2.
- DE LA CALZADA, C. S. 2015. A framework for clinical reasoning in adult cardiology. *Advances in Medical Education and Practices*, 6, 489-95.
- DEPARTMENT OF HEALTH. 2013. Delivering high quality, effective, compassionate care: developing the right people with the right skills and the right values. London: Department of Health.
- DIEMERS, A. D., DOLMANS, D. H., VERWIJNEN, M. G., HEINEMAN, E. & SCHERPBIER, A. J. 2008. Students' opinions about the effects of preclinical patient contacts on their learning. *Advances in Health Sciences Education: Theory and Practice*, 13, 633-47.
- DIEMERS, A. D., VAN DE WIEL, M. W., SCHERPBIER, A. J., BAARVELD, F. & DOLMANS, D. H. 2015. Diagnostic reasoning and underlying knowledge of students with preclinical patient contacts in PBL. *Medical Education*, 49, 1229-38.
- DIEMERS, A. D., VAN DE WIEL, M. W., SCHERPBIER, A. J., HEINEMAN, E. & DOLMANS, D. H. 2011. Pre-clinical patient contacts and the application of biomedical and clinical knowledge. *Medical Education*, 45, 280-8.
- DORY, V., DEGRYSE, J., ROEX, A. & VANPEE, D. 2010a. Usable knowledge, hazardous ignorance - beyond the percentage correct score. *Medical Teacher*, 32, 375-80.
- DORY, V., GAGNON, R. & CHARLIN, B. 2010b. Is case-specificity content-specificity? An analysis of data from extended-matching questions. *Advances in Health Sciences Education: Theory and Practice*, 15, 55-63.
- DOUST, J. 2009. Using probabilistic reasoning. *BMJ*, 339, b3823-b3823.

- DREYFUS, S. E. 2004. The Five-Stage Model of Adult Skill Acquisition. *Bulletin of Science, Technology & Society*, 24, 177-181.
- DUNCAN, B., HART, G., SCOLAR, A. & BIGRIGG, A. 2001. Qualitative analysis of psychosocial impact of diagnosis of Chlamydia trachomatis: implications for screening. *BMJ*, 322, 195-9.
- DURNING, S., ARTINO, A. R., PANGARO, L., VAN DER VLEUTEN, C. P. & SCHUWIRTH, L. 2011. Context and clinical reasoning: understanding the perspective of the expert's voice. *Medical Education*, 45, 927-38.
- DURNING, S. J., ARTINO, A., BOULET, J., VAN DER VLEUTEN, C. P., LA ROCHELLE, J., ARZE, B. & SCHUWIRTH, L. 2010a. Making use of contrasting participant views of the same encounter. *Medical Education*, 44, 953-61.
- DURNING, S. J., ARTINO, A. R., BOULET, J. R., DORRANCE, K., VAN DER VLEUTEN, C. & SCHUWIRTH, L. 2012. The Impact of Selected Contextual Factors on Experts' Clinical Reasoning Performance: Does Context Impact Clinical Reasoning Performance in Experts. *Advances in Health Sciences Education*, 17, 65-79.
- DURNING, S. J., ARTINO, A. R., JR., PANGARO, L. N., VAN DER VLEUTEN, C. & SCHUWIRTH, L. 2010b. Perspective: redefining context in the clinical encounter: implications for research and training in medical education. *Academic Medicine*, 85, 894-901.
- DURNING, S. J., COSTANZO, M. E., ARTINO, A. R., GRANER, J., VAN DER VLEUTEN, C., BECKMAN, T. J., WITTICH, C. M., ROY, M. J., HOLMBOE, E. S. & SCHUWIRTH, L. 2015. Neural basis of nonanalytical reasoning expertise during clinical evaluation. *Brain and Behavior*, 5, e00309.
- DURNING, S. J., COSTANZO, M. E., BECKMAN, T. J., ARTINO, A. R., JR., ROY, M. J., VAN DER VLEUTEN, C., HOLMBOE, E. S., LIPNER, R. S. & SCHUWIRTH, L. 2016. Functional neuroimaging correlates of thinking flexibility and knowledge structure in memory: Exploring the relationships between clinical reasoning and diagnostic thinking. *Medical Teacher*, 38, 570-7.
- DURNING, S. J., ELNICKI, M. E., GRUPPEN, L., TORRE, D. & HEMMER, P. A. 2010c. AMEE 2009 spotlight on educational research. *Medical Teacher*, 32, 340-2.
- EDGLEY, A., STICKLEY, T., TIMMONS, S. & MEAL, A. 2014. Critical realist review: exploring the real, beyond the empirical. *Journal of Further and Higher Education*, 40, 316-330.
- ELSTEIN, A. S. 1978. *Medical problem solving: an analysis of clinical reasoning*. Cambridge, Mass: Harvard U.P.
- ELSTEIN, A. S. & SCHWARTZ, A. 2002. Clinical problem solving and diagnostic decision making: selective review of the cognitive literature. *BMJ*, 324, 729-32.
- ELSTEIN, A. S., SHULMAN, L. S. & SPRAFKA, S. A. 1981. Medical problem- solving. *Journal of medical education*, 56, 75-76.
- ENGLER, C. M., SALTZMAN, G. A., WALKER, M. L. & WOLF, F. M. 1981. Medical student acquisition and retention of communication and interviewing skills. *Journal of Medical Education*, 56, 572-9.
- EPSTEIN, R. M. 2007. Assessment in medical education. *The New England Journal of Medicine*, 356, 387-96.
- EPSTEIN, S. 1994. Integration of the Cognitive and the Psychodynamic Unconscious. *American Psychologist*, 49, 709-724.
- ERICSSON, K. A. 1993. *Protocol analysis: verbal reports as data*. Cambridge, Mass: MIT Press.
- ERICSSON, K. A. 2002. Towards a procedure for eliciting verbal expression of non-verbal experience without reactivity: interpreting the verbal overshadowing effect within the theoretical framework for protocol analysis. *Applied Cognitive Psychology*, 16, 981-987.
- ERICSSON, K. A., KRAMPE, R. T. & TESCH-RÖMER, C. 1993. The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, 100, 363-406.
- ESPARAZ, E. S., BINDER, S. B. & BORGES, N. J. 2014. How prepared are medical students to diagnose and manage common ocular conditions. *Journal of Educational Evaluation for Health Professions*, 11, 29.
- EVA, K. W. 2005. What every teacher needs to know about clinical reasoning. *Medical Education*. 39, 98-106.

- EVA, K. W., HATALA, R. M., LEBLANC, V. R. & BROOKS, L. R. 2007. Teaching from the clinical reasoning literature: combined reasoning strategies help novice diagnosticians overcome misleading information. *Medical Education*, 41, 1152-1158.
- EVA, K. W., NORMAN, G. R., NEVILLE, A. J., WOOD, T. J. & BROOKS, L. R. 2002. Expert-novice differences in memory: a reformulation. *Teaching and Learning in Medicine*, 14, 257-63.
- EVA, R. A., HORSFALL, S. & LEE, M. E. 1997. *Chaos, Complexity and Sociology: Myths, Models and Theories*, Thousand Oaks, Calif: SAGE Publications.
- EVA, W., KEVIN, NEVILLE, J., ALAN & NORMAN, R., GEOFFREY 1998. Exploring the Etiology of Content Specificity: Factors Influencing Analogic Transfer and Problem Solving. *Academic Medicine*, 73, S1-5.
- EVANS, J. S. 2008. Dual-processing accounts of reasoning, judgment, and social cognition. *Annual Review of Psychology*, 59, 255-78.
- EVANS, J. S. & STANOVICH, K. E. 2013. Dual-Process Theories of Higher Cognition: Advancing the Debate. *Perspectives on Psychological Science*, 8, 223-41.
- EVANS, J. S. B. T. 2007. On the resolution of conflict in dual process theories of reasoning. *Thinking & Reasoning*, 13, 321-339.
- EVANS, J. S. B. T. 2010. *Thinking twice: Two minds in one brain*, Oxford, England: Oxford University Press.
- FERREIRA, B., RIBEIRO, A. P., FERREIRA, R. F., RAJGOR, D., SHAH, J., MENEZES, A. & PIETROBON, R. F., ATLE (EDITOR) 2010. Clinical Reasoning in the Real World Is Mediated by Bounded Rationality: Implications for Diagnostic Clinical Practice Guidelines (Clinical Reasoning). *PLoS ONE*, 5, e10265.
- FINCH, E. 1958. The centenary of the General Council of Medical Education and Registration of the United Kingdom (The General Medical Council) 1858-1958 in relation to medical education. *Annals of the Royal College of Surgeons of England*, 23, 321-31.
- FISCHER, M. R., KOPP, V., HOLZER, M., RUDERICH, F. & JUNGER, J. 2005. A modified electronic key feature examination for undergraduate medical students: validation threats and opportunities. *Med Teach*, 27, 450-5.
- FLEETWOOD, S. 2017. The critical realist conception of open and closed systems. *Journal of Economic Methodology*, 24, 41-68.
- FLETCHER, A. J. 2017. Applying critical realism in qualitative research: methodology meets method. *International Journal of Social Research Methodology*, 20, 181-194.
- FLEXNER, A. 1910. *Medical Education in the United States and Canada: A Report To the Carnegie Foundation For the Advancement of Teaching*. New York, NY, USA: The Carnegie Foundation for the Advancement of Teaching.
- FLYVBJERG, B. 2006. Five Misunderstandings About Case-Study Research. *Qualitative Inquiry*, 12, 219-245.
- FRASER, K., MA, I., TETERIS, E., BAXTER, H., WRIGHT, B. & MCLAUGHLIN, K. 2012. Emotion, cognitive load and learning outcomes during simulation training. *Medical Education*, 46, 1055-1062.
- FRASER, R. C., MCKINLEY, R. K. & MULHOLLAND, H. 1994. Consultation competence in general practice: testing the reliability of the Leicester assessment package. *The British Journal of General Practice*, 44, 293-6.
- GARDNER, A. K., SCOTT, D. J., HEBERT, J. C., MELLINGER, J. D., FREY-VOGEL, A., TEN EYCK, R. P., DAVIS, B. R., SILLIN, L. F., 3RD & SACHDEVA, A. K. 2015. Gearing up for milestones in surgery: Will simulation play a role? *Surgery*. 158, 1421-1427.
- GARNER, R. 1988. Verbal-report data on cognitive and metacognitive strategies. In: WEINSTEIN, C., GOETZ, E. & ALEXANDER, P. (eds.) *Learning and study strategies: Issues in assessment, instruction and evaluation*. New York: Academic Press.
- GASS, S. M. & MACKKEY, A. 2000. *Stimulated Recall Methodology in Second Language Research*, Mahwah, New Jersey: Lawrence Erlbaum.
- GENERAL MEDICAL COUNCIL 1993. Tomorrow's doctors: recommendations on undergraduate medical education. In: COMMITTEE, E. (ed.). London.
- GENERAL MEDICAL COUNCIL 2015. *Promoting Excellence: Standards for medical education and training*. Report Published 15 July 2015.
- GERGEN, K. 1999. *An Invitation to Social Construction*. London: Sage.

- GERRISH, K. L. 2010. *The Research Process in Nursing*. Oxford: Blackwell Publishing Ltd.
- GESUNDHEIT, N., BRUTLAG, P., YOUNGBLOOD, P., GUNNING, W. T., ZARY, N. & FORS, U. 2009. The use of virtual patients to assess the clinical skills and reasoning of medical students: Initial insights on student acceptance. *Medical Teacher*, 31, 739-742.
- GIDDENS, A. 1976. *New Rules of Sociological Method*. London: Hutchinson.
- GIGERENZER, G. 2010. Personal Reflections on Theory and Psychology. *Theory & Psychology*, 20, 733-743.
- GLEICK, J. 1988. *Chaos: making a new science*, London: Cardinal.
- GOLSWORTHY, R. & COYLE, A. 2001. Practitioners' accounts of religious and spiritual dimensions in bereavement therapy. *Counselling Psychology Quarterly*, 14, 183-202.
- GOODWIN, N., DIXON, A., POOLE, T. & RALEIGH, V. 2011. *King's Fund report on improving the quality of care in general practice*. The Nuffield Trust.
- GOSS, B., REID, K., DODDS, A. & MCCOLL, G. 2011. Comparison of medical students' diagnostic reasoning skills in a traditional and a problem based learning curriculum. *International Journal of Medical Education*, 2, 87-93.
- GOYDER, C. R., JONES, C. H., HENEGHAN, C. J. & THOMPSON, M. J. 2015. Missed opportunities for diagnosis: lessons learned from diagnostic errors in primary care. *British Journal of General Practice*, 65, e838-44.
- GRABER, M. 2005. Diagnostic errors in medicine: a case of neglect. *Joint Commission Journal of Quality and Patient Safety*, 31, 106-13.
- GRABER, M. L. 2013. The incidence of diagnostic error in medicine. *BMJ Quality and Safety*, 22 Suppl 2, ii21-ii27.
- GRABER, M. L., FRANKLIN, N. & GORDON, R. 2005. Diagnostic error in internal medicine. *Archives of Internal Medicine*, 165, 1493-9.
- GREENAWAY, D. 2013. Securing the future of excellent patient care: final report of the independent review led by Professor David Greenaway. *Shape of Training review*. 29 Oct 2013.
- GRIFFITHS, R. 1983. NHS Management Inquiry Report. The inside view. Interview by Steve Weaving. *RCN Nursing Standard*, 5.
- GRUPPEN, L. & FROHNA, A. 2002. Clinical reasoning. In: NORMAN, G., VAN DER VLEUTEN, C. & NEWBLE, D. (eds.). *International handbook of research in medical education*. Boston, MA: Kluwer Academic.
- GRUPPEN, L. D., WOOLLISCROFT, J. O. & WOLF, F. M. 1988. The contribution of different components of the clinical encounter in generating and eliminating diagnostic hypotheses. *Research in Medical Education*, 27, 242-7.
- GUBA, E. G. & LINCOLN, Y. S. 1989. *Fourth Generation Evaluation*. CA, Newbury Park: Sage.
- GUDE, T., VAGLUM, P., ANVIK, T., BAERHEIM, A. & GRIMSTAD, H. 2013. A few more minutes make a difference? The relationship between content and length of GP consultations. *Scandinavian Journal of Primary Health Care*, 31, 31-5.
- HABERMAS, J. 1978. *Knowledge and Human Interests*. 2nd edition ed. London: Heinemann.
- HAFFLING, A. C., BECKMAN, A., PAHLMBLAD, A. & EDGREN, G. 2010. Students' reflections in a portfolio pilot: highlighting professional issues. *Medical Teacher*, 32, e532-40.
- HAM, C. 2009. *Health policy in Britain*, Basingstoke, Basingstoke : Palgrave Macmillan.
- HAMMOND, K. R. 1996. *Human judgment and social policy : irreducible uncertainty, inevitable error, unavoidable injustice*, New York, New York : Oxford University Press.
- HARDEN, R. M. & GLEESON, F. A. 1979. Assessment of clinical competence using an objective structured clinical examination format: reliability and generalizability. *Medical Education*, 30, 38-43.
- HARDEN, R. M., STEVENSON, M., DOWNIE, W. W. & WILSON, G. M. 1975. Assessment of clinical competence using objective structured examination. *British Medical Journal*, 1, 447-51.
- HARDING, A., ROSENTHAL, J., AL-SEADY, M., GRAY, D. P. & MCKINLEY, R. K. 2015. Provision of medical student teaching in UK general practices: a cross-sectional questionnaire study. *The British journal of general practice: the journal of the Royal College of General Practitioners*, 65, e409.
- HARRE, R. 1979. *Social being*. Oxford, UK: Blackwell.

- HASTINGS, A., MCKINLEY, R. K. & FRASER, R. C. 2006. Strengths and weaknesses in the consultation skills of senior medical students: identification, enhancement and curricular change. *Medical Education*, 40, 437-43.
- HAYES, G. J. 1994. Issues of consent: the use of the recently deceased for endotracheal intubation training. *The Journal of Clinical Ethics*, 5, 211-6.
- HEFFERON, K. & GIL-RODRIGUEZ, E. 2011. Methods: Interpretative phenomenological analysis. *The Psychologist*, 24, 756-759.
- HELMERS, K. F., DANOFF, D., STEINERT, Y., LEYTON, M. & YOUNG, S. N. 1997. Stress and depressed mood in medical students, law students, and graduate students at McGill University. *Academic Medicine*, 72, 708-14.
- HENDERSON, L. & TALLMAN, J. 2006. *Stimulated Recall and Mental Models*, Lanham, MD, The Scarecrow Press.
- HENEGHAN, C., GLASZIOU, P., THOMPSON, M., ROSE, P., BALLA, J., LASSERSON, D., SCOTT, C. & PERERA, R. 2009. Diagnostic strategies used in primary care. *BMJ*, 338, b946.
- HENRY, S. G. 2010. Polanyi's tacit knowing and the relevance of epistemology to clinical medicine. *Journal of Evaluation in Clinical Practice*, 16, 292-297.
- HIGGINS, R., GALLEN, D. & WHITEMAN, S. 2005. Meeting the non-clinical education and training needs of new consultants. *Postgraduate Medical Journal*, 81, 519-23.
- HOBU, P. P. M., SCHMIDT, H. G., BOSHUIZEN, H. P. A. & PATEL, V. L. 1987. Contextual factors in the activation of first diagnostic hypotheses: expert-novice differences. *Medical Education*, 21, 471-476.
- HODGES, B., REGEHR, G., MCNAUGHTON, N., TIBERIUS, R. & HANSON, M. 1999. OSCE checklists do not capture increasing levels of expertise. *Academic Medicine*, 74, 1129-34.
- HODGES, B. D. 2007. *A Socio-historical Study of the Birth and Adoption of the Objective Structured Clinical Examination (OSCE)*. University of Toronto.
- HOLLANDER, M., WOLFE, D. A. & CHICKEN, E. 1999. *Nonparametric Statistical Methods*, New York NY, John Wiley and Sons, Inc.
- HOLTMAN, M. C. 2011. Paradoxes of professionalism and error in complex systems. *Journal of biomedical informatics*, 44, 395-401.
- HOOK, K. M. & PFEIFFER, C. A. 2007. Impact of a new curriculum on medical students' interpersonal and interviewing skills. *Medical Education*, 41, 154-9.
- HOWE, K. R., HOLMES, M. & ELSTEIN, A. S. 1984. Teaching clinical decision making. *The Journal of medicine and philosophy*, 9, 215-228.
- HRUSKA, P., KRIGOLSON, O., CODERRE, S., MCLAUGHLIN, K., CORTESE, F., DOIG, C., BERAN, T., WRIGHT, B. & HECKER, K. G. 2016. Working Memory, Reasoning, and Expertise in Medicine--Insights into Their Relationship Using Functional Neuroimaging. *Advances in Health Sciences Education*, 21, 935-952.
- HUMBERT, A. J., BESINGER, B. & MIECH, E. J. 2011. Assessing clinical reasoning skills in scenarios of uncertainty: convergent validity for a Script Concordance Test in an emergency medicine clerkship and residency. *Academic Emergency Medicine*, 18, 62734.
- HUSSERL, E. 1927. "Phenomenology" For Encyclopaedia Britannica. (Palmer, R. Trans. and revised). Available at: <https://www.scribd.com/doc/60798124/Husserl-Encyclopedia-Britannica-Article>. [Accessed 19.04.2018]
- ILLING, J., MORROW, G., KERGON, C., BURFORD, B., SPENCER, J., PEILE, E., DAVIES, C., BALDAUF, B., ALLEN, M., JOHNSON, N., MORRISON, J., DONALDSON, M., WHITELAW, M. & FIELD, M. 2008. *How Prepared Are Medical Graduates to Begin Practice? A Comparison of Three Diverse UK Medical Schools*. Final report to GMC April 2008. Project Report.
- ISSENBERG, S. B., MCGAGHIE, W. C., PETRUSA, E. R., LEE GORDON, D. & SCALESE, R. J. 2005. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. *Medical Teacher*, 27, 10-28.
- JAEGER, M. E. & ROSNOW, R. L. 1988. Contextualism and its implications for psychological inquiry. *British Journal of Psychology*, 79, 63-75.
- JAMIESON, S. 2004. Likert scales: how to (ab)use them. *Medical Education*, 38, 1217-1218.

- JESSON, J. K., MATHESON, L. & LACEY, F. M. 2011. Doing your literature review: Traditional and systematic techniques. London, UK: SAGE Publications Ltd.
- JOHNSON, R. B., ONWUEGBUZIE, A. J. & TURNER, L. A. 2007. Toward a Definition of Mixed Methods Research. *Journal of Mixed Methods Research*, 1, 112–33.
- JONES, R. 2009. Generation Me and us. *Medical Education*, 43, 819.
- JOSEPH, G. M. & PATEL, V. L. 1990. Domain knowledge and hypothesis generation in diagnostic reasoning. *Medical Decision Making*, 10, 31–46.
- JOËLS, M., PU, Z., WIEGERT, O., OITZL, M. S. & KRUGERS, H. J. 2006. Learning under stress: how does it work? *Trends in Cognitive Sciences*, 10, 152–158.
- JUNOD PERRON, N., LOUIS-SIMONET, M., CERUTTI, B., PFARRWALLER, E., SOMMER, J. & NENDA Z, M. 2016. Feedback in formative OSCEs: comparison between direct observation and video-based formats. *Medical Education Online*, 21, 32160.
- JUNOD PERRON, N., SOMMER, J., LOUIS-SIMONET, M. & NENDA Z, M. 2015. Teaching communication skills: beyond wishful thinking. *Swiss Medical Weekly*, 145, w14064.
- KAHNEMAN, D. 2012. *Thinking, fast and slow*, London, UK: Penguin.
- KALANITI, K. & CAMPBELL, D. 2015. Simulation-based medical education: Time for a pedagogical shift. *Indian Pediatrics*, 52, 41–45.
- KALDJIAN, L. C., WU, B. J., JEKEL, J. F., KALDJIAN, E. P. & DUFFY, T. P. 1999. Insertion of femoral-vein catheters for practice by medical house officers during cardiopulmonary resuscitation. *The New England Journal of Medicine*, 341, 2088–91.
- KALYUGA, S., AYRES, P., CHANDLER, P. & SWELLER, J. 2003. The Expertise Reversal Effect. *Educational Psychologist*, 38, 23–31.
- KARSENTY, L. 2001. Adapting verbal protocol methods to investigate speech systems use. *Applied Ergonomics*, 32, 15–22.
- KASSIRER, J. P. 1995. Teaching Problem- Solving — How Are We Doing? *The New England Journal of Medicine*, 332, 1507–1509.
- KEIFENHEIM, K. E., TEUFEL, M., IP, J., SPEISER, N., LEEHR, E. J., ZIPFEL, S. & HERRMANN-WERNER, A. 2015. Teaching history taking to medical students: a systematic review. *BMC Medical Education*, 15, 159.
- KER, J. & BRADLEY, P. 2010. Simulation in Medical Education. In: *Understanding Medical Education: Evidence, Theory and Practice*. SWANWICK, T. (ed.). Oxford, UK: Wiley-Blackwell.
- KEREN, G. & SCHUL, Y. 2009. Two Is Not Always Better Than One: A Critical Evaluation of Two- System Theories. *Perspectives on Psychological Science*, 4, 533–550.
- KIESEWETTER, J., EBERSBACH, R., GÖRLITZ, A., HOLZER, M., FISCHER, M. R. & SCHMIDMAIER, R. 2013. Cognitive Problem Solving Patterns of Medical Students Correlate with Success in Diagnostic Case Solutions. *PLoS One*, 8, e71486.
- KLEMENC-KETIS, Z. & KERSNIK, J. 2014. Deficiency areas in decision making in undergraduate medical students. *Advances in medical education and practice*, 5, 223.
- KRUGLANSKI, A. W. & GIGERENZER, G. 2011. Intuitive and deliberate judgments are based on common principles. *Psychological Review*, 118, 97–109.
- KRUPAT, E., WORMWOOD, J., SCHWARTZSTEIN, R. M. & RICHARDS, J. B. 2017. Avoiding premature closure and reaching diagnostic accuracy: some key predictive factors. *Medical Education*, 51, 1127–1137.
- KUIPER, R. A. & PESUT, D. J. 2004. Promoting cognitive and metacognitive reflective reasoning skills in nursing practice: self-regulated learning theory. *Journal of Advanced Nursing*, 45, 381–91.
- KUPER, A., REEVES, S., ALBERT, M. & HODGES, B. D. 2007. Assessment: do we need to broaden our methodological horizons? *Medical Education*, 41, 1121–3.
- KUSHNIRUK, A. W., PATEL, V. L. & MARLEY, A. A. 1998. Small worlds and medical expertise: implications for medical cognition and knowledge engineering. *International journal of medical informatics*, 49, 255.
- LANGDRIDGE, D. 2007. *Phenomenological Psychology: Theory, Research, and Method*, Harlow, UK: Pearson Education.
- LARKIN, M., WATTS, S. & CLIFTON, E. 2006. Giving voice and making sense in interpretative phenomenological analysis. *Qualitative Research in Psychology*, 3, 102–120.

- LARKING, D. & THOMPSON, A. R. 2012. Interpretative phenomenological analysis. In: THOMPSON, A. & HARPER, D. (eds.) *Qualitative research methods in mental health and psychotherapy: a guide for students and practitioners*. Oxford: John Wiley & Sons.
- LARSSON, J. & HOLMSTRÖM, I. 2007. Phenomenographic or phenomenological analysis: does it matter? Examples from a study on anaesthesiologists' work. *Journal International Journal of Qualitative Studies on Health and Well-being*, 2.
- LEBLANC, V. R., BROOKS, L. R. & NORMAN, G. R. 2002. Believing is seeing: the influence of a diagnostic hypothesis on the interpretation of clinical features. *Academic Medicine*, 77, S67-9.
- LEHMANN, E. L. 1975. *Nonparametrics: Statistical methods based on ranks*, San Francisco, Holden-Day.
- LEUNG, W. C. 2002. Competency based medical training: review. *Bmj*, 325, 693-6.
- LEVINE, D. 2014. The importance of clinical reasoning in the training of all medical practitioners. *Journal of the Royal Society of Medicine*, 107, 178.
- LEWIS-BECK, M. S., BRYMAN, A. & LIAO, T. F. 2004. *The SAGE Encyclopedia of Social Science Research Methods*. Thousand Oaks: SAGE Publications, Inc.
- LIPSCOMB, M. 2008. Mixed method nursing studies: a critical realist critique. *Nursing Philosophy*, 9, 32-45.
- LLOYD, M. H. & ROSENTHAL, J. J. 1992. The contribution of general practice to medical education: expectations and fulfillment. *Medical Education*, 26, 488-96.
- LOKE, S. K., TORDOFF, J., WINIKOFF, M., MCDONALD, J., VLUGTER, P. & DUFFULL, S. 2011. SimPharm: How pharmacy students made meaning of a clinical case differently in paper- and simulation-based workshops. *British Journal of Educational Technology*, 42, 865-874.
- LUDMERER, M. K. 2010. Commentary: Understanding the Flexner Report. *Academic Medicine*, 85, 193-196.
- LUKACS, P. K. 2009. Defining: Original Contribution to Knowledge. *Sunday*, May 3rd 2009.
- LYNÖE, S., SANDLUND, L., WESTBERG, O. & DUCHEK, W. 1998. Informed consent in clinical training – patient experiences and motives for participating. *Medical Education*, 32, 465-471.
- LYONS, K., MCLAUGHLIN, J. E., KHANOVA, J. & ROTH, M. T. 2016. Cognitive apprenticeship in health sciences education: a qualitative review. *Advances in Health Science Education: Theory and Practice*, 22, 723-739.
- MALHOTRA, A., GREGORY, I., DARVILL, E., GOBLE, E., PRYCE-ROBERTS, A., LUNDBERG, K., KONRADSEN, S. & HAFSTAD, H. 2009. Mind the gap: Learners' perspectives on what they learn in communication compared to how they and others behave in the real world. *Patient Education and Counseling*, 76, 385-90.
- MAMEDE, S. & SCHMIDT, H. G. 2017. Reflection in Medical Diagnosis: A Literature Review. *Health Professions Education*, 3, 15-25.
- MAMEDE, S., SCHMIDT, H. G. & PENAFORTE, J. C. 2008. Effects of reflective practice on the accuracy of medical diagnoses. *Medical Education*, 42, 468-75.
- MAMEDE, S., VAN GOG, T., SAMPAIO, A. M., DE FARIA, R. M., MARIA, J. P. & SCHMIDT, H. G. 2014. How can students' diagnostic competence benefit most from practice with clinical cases? The effects of structured reflection on future diagnosis of the same and novel diseases. *Academic Medicine*, 89, 121-7.
- MANN, A., TATOR, C. H. & CARSON, J. D. 2017. Concussion diagnosis and management: Knowledge and attitudes of family medicine residents. *Canadian Family Physician*, 63, 460-466.
- MANOGUE, M. & BROWN, G. 1998. Developing and implementing an OSCE in dentistry. *European Journal of Dental Education*, 2, 51-7.
- MARAN, N. J. & GLAVIN, R. J. 2003. Low- to high-fidelity simulation – a continuum of medical education? *Medical Education*, 37, 22-28.
- MARCUM, J. A. 2012. An integrated model of clinical reasoning: dual-process theory of cognition and metacognition. *J Eval Clin Pract*, 18, 954-61.
- MARTIN, E. A. 1998. *Concise colour medical dictionary*. Oxford, UK: Oxford University Press.
- MARTIN, E. A. & MCFERRAN, T. A. 2014. *A Dictionary of Nursing*, Oxford, UK: Oxford University Press.

- MCEVOY, P. & RICHARDS, D. 2006. A critical realist rationale for using a combination of quantitative and qualitative methods. *Journal of Research in Nursing*, 11, 66 - 78.
- MCGAGHIE, W. C., ISSENBERG, S. B., COHEN, E. R., BARSUK, J. H. & WAYNE, D. B. 2011. Does Simulation-based Medical Education with Deliberate Practice Yield Better Results than Traditional Clinical Education? A Meta-Analytic Comparative Review of the Evidence. *Academic Medicine*, 86, 706-11.
- MCGAGHIE, W. C., ISSENBERG, S. B., PETRUSA, E. R. & SCALESE, R. J. 2010. A critical review of simulation-based medical education research: 2003–2009. *Medical Education*, 44, 50-63.
- MCGREGOR, C. A., PATON, C., THOMSON, C., CHANDRATILAKE, M. & SCOTT, H. 2012. Preparing medical students for clinical decision making: a pilot study exploring how students make decisions and the perceived impact of a clinical decision making teaching intervention. *Medical Teacher*, 34, e508-17.
- MEHDIZADEH, L. 2011. *Doctors' clinical decision making: using theory to develop an educational intervention*. PhD Thesis, University of Leeds.
- MILLER, G. A. & KINTSCH, W. 1994. The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information. *Psychological Review*, 101, 343-352.
- MILLER, G. E. 1990. The assessment of clinical skills/competence/performance. *Academic Medicine*, 65, S63-7.
- MILLER, L. L. 1997. Not Just Weapons of the Weak: Gender Harassment as a Form of Protest for Army Men. *Social Psychology Quarterly*, 60, 32-51.
- MINGERS, J. 2006. Philosophical Foundations: Critical Realism. *Realising Systems Thinking: Knowledge and Action in Management Science*. Boston, MA: Springer.
- MINGERS, J. 2014. *Systems Thinking, Critical Realism and Philosophy: A confluence of ideas*. Abingdon, Oxon: Routledge.
- MITCHELL, M. L., JEFFREY, C. A., HENDERSON, A., GLOVER, P., NULTY, D. D., KELLY, M. A., GROVES, M. & KNIGHT, S. 2014. Using an Objective Structured Clinical Examination for Bachelor of Midwifery students' preparation for practice. *Women and Birth: Journal of the Australian College of Midwives*, 27, 108-113.
- MONROUXE, L., BULLOCK, A., COLE, J., GORMLEY, G., KAUFHOLD, K., KELLY, N., MATTICK, K., REES, C. & SCHEFFLER, G. 2014. *How Prepared are UK Medical Graduates for Practice?* Final Report from a programme of research commissioned by the General Medical Council.
- MONROUXE, L. V., REES, C. E., DENNIS, I. & WELLS, S. E. 2015. Professionalism dilemmas, moral distress and the healthcare student: insights from two online UK-wide questionnaire studies. *BMJ Open*, 5, e007518.
- MORREL, D. C. 1993. *Diagnosis in general practice: Art of Science?* London: Nuffield Trust.
- MOSKOWITZ, A. J., KUIPERS, B. J. & KASSIRER, J. P. 1988. Dealing with uncertainty, risks, and tradeoffs in clinical decisions. A cognitive science approach. *Annals of Internal Medicine*, 108, 435-49.
- MURTAGH, J. 1990. Common problems: a safe diagnostic strategy. *Australian Family Physician*, 19, 733-4, 737, 740-2.
- MYUNG, S. J., KANG, S. H., PHYO, S. R., SHIN, J. S. & PARK, W. B. 2013. Effect of enhanced analytic reasoning on diagnostic accuracy: a randomized controlled study. *Medical Teacher*, 35, 248-50.
- NATIONAL ACADEMIES OF SCIENCES, E., AND MEDICINE 2015. *Improving Diagnosis in Health Care*. Washington, DC: The National Academic Press.
- NAYER, M. 1995. The assessment of clinical competency: an overview and preliminary report of Canadian physiotherapy programs. *Physiotherapy Canada*, 47, 190-9.
- NENDAZ, M. & PERRIER, A. 2012. Diagnostic errors and flaws in clinical reasoning: mechanisms and prevention in practice. *Swiss Medical Weekly*, 142, w13706.
- NENDAZ, M. R. & BORDAGE, G. 2002. Promoting diagnostic problem representation. *Medical Education*, 36, 760-6.
- NEUFELD, V. R., NORMAN, G. R., FEIGHTNER, J. W. & BARROWS, H. S. 1981a. Clinical problem-solving by medical students: a cross-sectional and longitudinal analysis. *Medical Education*, 15, 315-22.

- NEUFELD, V. R., NORMAN, G. R., FEIGHTNER, J. W. & BARROWS, H. S. 1981b. Clinical problem-solving by medical students: a cross-sectional and longitudinal analysis. *Medical Education*, 15, 315-322.
- NGUYEN, N., MCFADDEN, A., TANGEN, D. & BEUTEL, D. 2013. Video-stimulated recall interviews in qualitative research. *AARE Conference*. Adelaide.
- NICOL, M. & FREETH, D. 1998. Assessment of Clinical Skills: A New Approach to an Old Problem. *Nurse Education Today*, 18, 601-09.
- NORCINI, J. J., LIPNER, R. S. & KIMBALL, H. R. 2002. Certifying examination performance and patient outcomes following acute myocardial infarction. *Medical Education*, 36, 8539.
- NORMAN, G. 2005a. Editorial -- inverting the pyramid. *Advances in Health Science Education: Theory and Practice*, 10, 85-8.
- NORMAN, G. 2005b. Research in clinical reasoning: past history and current trends. *Medical Education*, 39, 418-27.
- NORMAN, G. 2009. Dual Processing and Diagnostic Errors. *Advances in Health Sciences Education*, 14, 37-49.
- NORMAN, G., YOUNG, M. & BROOKS, L. 2007. Non-analytical models of clinical reasoning: the role of experience. *Medical Education*, 41, 1140-1145.
- NORMAN, G. R. & EVA, K. W. 2010. Diagnostic error and clinical reasoning. *Medical Education*, 44, 94-100.
- NORMAN, G. R., TUGWELL, P., FEIGHTNER, J. W., MUZZIN, L. J. & JACOBY, L. L. 1985. Knowledge and clinical problem-solving. *Medical Education*, 19, 344-356.
- OSBORN, M. & SMITH, J. A. 1998. The personal experience of chronic benign lower back pain: An interpretative phenomenological analysis. *British Journal of Health Psychology*, 3, 65-83.
- OSMAN, M. 2004. An evaluation of dual-process theories of reasoning. *Psychonomic Bulletin and Review*, 11, 988-1010.
- PAAS, F., RENKL, A. & SWELLER, J. 2003. Cognitive Load Theory and Instructional Design: Recent Developments. *Educational Psychologist*, 38, 1-4.
- PAGE, G. G. & FIELDING, D. W. 1980. Performance on PMPs and performance in practice: are they related. *Journal of Medical Education*, 55, 529-537.
- PAGE, G. R., MATTHAN, J., SILVA, A. L. & MCLAUGHLIN, D. P. 2016. Mapping the delivery of clinical reasoning in UK undergraduate curricula. *A Special Interest Group of the Wolfson Research Institute for Health & Wellbeing*. Durham University.
- PAIGE, J. T., ARORA, S., FERNANDEZ, G. & SEYMOUR, N. 2015. Debriefing 101: training faculty to promote learning in simulation-based training. *American Journal of Surgery*, 209, 126-31.
- PAIS, A. 1991. The uncertainty relations, with a look back at the correspondence principle. In: BOHR, N. (ed.) *Times: Physics, Philosophy, and Polity*. Oxford, UK: Oxford University Press.
- PANESAR, S., CARSON-STEVENSON, A., SALVILLA, S. & SHEIKH, A. 2014. *Patient safety and healthcare improvement*, Chichester, Wiley Blackwell.
- PARK, W. B., KANG, S. H., LEE, Y. S. & MYUNG, S. J. 2015. Does Objective Structured Clinical Examinations Score Reflect the Clinical Reasoning Ability of Medical Students? *The American Journal of the Medical Sciences*, 350, 64-7.
- PASKINS, Z., MCHUGH, G. & HASSELL, A. B. 2014. Getting under the skin of the primary care consultation using video stimulated recall: a systematic review. *BMC Medical Research Methodology*, 14, 101.
- PATEL, V., GROEN, G. & AROCHA, J. 1990. Medical expertise as a function of task difficulty. *Memory & Cognition*, 18, 394-406.
- PATEL, V. L., COHEN, T., MURARKA, T., OLSEN, J., KAGITA, S., MYNENI, S., BUCHMAN, T. & GHAEMMAGHAMI, V. 2011. Recovery at the edge of error: debunking the myth of the infallible expert. *Journal of Biomedical Informatics*, 44, 41324.
- PATEL, V. L. & GROEN, G. J. 1991. The general and specific nature of medical expertise: A critical look. In: K.A., E. & SMITH, J. (eds.) *Toward a general theory of expertise: Prospects and limits*. New York: Cambridge University Press.

- PATTON, M. Q. 2002. *Qualitative research and evaluation methods*, London, Sage Publications, Inc.
- PEDERSEN, D., TREMBLAY, J., ERRAZURIZ, C. & GAMARRA, J. 2008. The sequelae of political violence: assessing trauma, suffering and dislocation in the Peruvian highlands. *Social Science and Medicine*, 67, 205-17.
- PELACCIA, T., TARDIF, J., TRIBY, E. & CHARLIN, B. 2011. An analysis of clinical reasoning through a recent and comprehensive approach: the dual-process theory. *Medical Education Online*, 16, 10.3402/meo.v16i0.5890.
- PETEK STER, M., SVAB, I. & STER, B. 2014. Final year medical students' understanding of family medicine. *Acta Medica Academica*, 43, 40-9.
- PETT, M. A. 1997. *Non-parametric statistics for health care research*, London, SAGE Publications.
- PIETKIEWICZ, I. & SMITH, J. 2012. Praktyczny przewodnik interpretacyjnej analizy fenomenologicznej w badaniach jakościowych w psychologii. *Czasopismo Psychologiczne.*, 18, 361-369.
- PLASS, J. L., MORENO, R., & BRUNKEN, R. 2010. *Individual Differences and Cognitive Load Theory (Chapter 4) - Cognitive Load Theory*, New York, NY, Cambridge University Press.
- PONNAMPERUMA, G. G., KARUNATHILAKE, I. M., MCALEER, S. & DAVIS, M. H. 2009. The long case and its modifications: a literature review. *Medical Education*, 43, 936-941.
- POTTER, J. & WETHERELL, M. 1987. *Discourse and Social Psychology: Beyond Attitudes and Behaviour*, London, SAGE Publications, Inc.
- POWER, M. 1997. *The audit society rituals of verification*. Oxford, England: Oxford University Press.
- PRINCE, K., VAN DE WIEL, M., SCHERPBIER, A., CAN DER VLEUTEN, C. & BOSHIJZEN, H. 2000. A Qualitative Analysis of the Transition from Theory to Practice in Undergraduate Training in a PBL-Medical School. *Theory and Practice*, 5, 105-116.
- PRINCE, K. J., BOSHIJZEN, H. P., VAN DER VLEUTEN, C. P. & SCHERPBIER, A. J. 2005. Students' opinions about their preparation for clinical practice. *Medical Education*, 39, 704-12.
- QIAO, Y. Q., SHEN, J., LIANG, X., DING, S., CHEN, F. Y., SHAO, L., ZHENG, Q. & RAN, Z. H. 2014. Using cognitive theory to facilitate medical education. *BMC Medical Education*, 14, 79.
- RAM, P., VAN DER VLEUTEN, C., RETHANS, J. J., SCHOUTEN, B., HOBMA, S. & GROL, R. 1999. Assessment in general practice: the predictive value of written-knowledge tests and a multiple-station examination for actual medical performance in daily practice. *Medical Education*, 33, 197-203.
- RAMANAYAKE, R. P., DE SILVA, A. H., PERERA, D. P., SUMANASEKARA, R. D., GUNASEKARA, R. & CHANDRASIRI, P. 2015. Evaluation of teaching and learning in family medicine by students: a sri lankan experience. *Journal of Family Medicine and Primary Care*, 4, 3-8.
- RAMSEY, P. G., CARLINE, J. D., INUI, T. S., LARSON, E. B., LOGERFO, J. P. & WENRICH, M. D. 1989. Predictive validity of certification by the American Board of Internal Medicine. *Annals of Internal Medicine*, 110, 719-26.
- RAMSEY, P. G., WENRICH, M. D., CARLINE, J. D., INUI, T. S., LARSON, E. B. & LOGERFO, J. P. 1993. Use of Peer Ratings to Evaluate Physician Performance. *Survey of Anesthesiology*, 39, 359.
- RANGLES, R. H. & WOLFE, D. A. 1979. *Introduction to the Theory of Nonparametric Statistics.*, New York, John Wiley & Sons.
- REES, C. E. & MONROUXE, L. V. 2011. Medical students learning intimate examinations without valid consent: a multicentre study. *Medical education*, 45, 261.
- REID, K., FLOWERS, P. & LARKIN, M. 2005. Exploring the lived experience. *The Psychologist*, 18, 20-23.
- RETHANS, J. J., NORCINI, J. J., BARÓN-MALDONADO, M., BLACKMORE, D., JOLLY, B. C., LADUCA, T., LEW, S., PAGE, G. G. & SOUTHGATE, L. H. 2002. The relationship between competence and performance: implications for assessing practice performance. *Medical Education*, 36, 901-909.

- RETHANS, J. J., STURMANS, F., DROP, R., VAN DER VLEUTEN, C. & HOBUS, P. 1991. Does competence of general practitioners predict their performance. *BMJ*, 303, 1377-1380.
- RICOEUR, P. 1970. *Freud and Philosophy: An essay on interpretation*. New Haven: Yale University Press.
- RIDSDALE, L., EVANS, A., JERRETT, W., MANDALIA, S., OSLER, K. & VORA, H. 1993. Patients With Fatigue In General Practice: A Prospective Study. *BMJ: British Medical Journal*, 307, 103-106.
- RISJORD, M., MOLONEY, M. & DUNBAR, S. 2001. Methodological Triangulation in Nursing Research. *Philosophy of the Social Sciences*, 31, 40-59.
- RISJORD, M. W., DUNBAR, S. B. & MOLONEY, M. F. 2002. A New Foundation for Methodological Triangulation. *Journal of Nursing Scholarship*, 34, 269-75.
- RISSE, J., BUSATO, T., DUFROST, V., PERRI, M., ZUILY, S. & WAHL, D. 2017. Development of an objective structured clinical examination (OSCE) for evaluating clinical competence in vascular medicine. *Journal de Medecine Vasculaire*, 42, 141-147.
- ROGOWSKA-SZADKOWSKA, D. & CHLABICZ, S. 2010. Does the poor HIV/AIDS knowledge among medical students may contribute to late diagnosis? *Przegląd Epidemiologiczny*, 64, 41-5.
- ROLFE, G. 1999. Insufficient Evidence: The Problems of Evidence-Based Nursing. *Nurse Education Today*, 19, 433-42.
- ROUND, A. P. 1999. Teaching clinical reasoning--a preliminary controlled study. *Medical Education*, 33, 480-483.
- RUDEBECK, C. E. 1992. Symptoms and symptom presentation. *Scandinavian journal of primary health care Supplement*, 10 Suppl, 48-60.
- SALMON, P. & YOUNG, B. 2011. Is clinical communication pedagogy really as good as it iLITMs going to get? *Medical Education*, 45, 961-962.
- SANTEN, S. A., HEMPHILL, R. R., MCDONALD, M. F. & JO, C. O. 2004. Patients' willingness to allow residents to learn to practice medical procedures. *Academic Medicine*, 79, 1447.
- SANTEN, S. A., HEMPHILL, R. R., SPANIER, C. M. & FLETCHER, N. D. 2005. 'Sorry, it's my first time!' Will patients consent to medical students learning procedures? *Medical Education*, 39, 365-9.
- SAPPINGTON, T. E. 1984. Creating learning environments conducive to change: The role of fear/safety in the learning process. *Innovative Higher Education*, 9, 19-29.
- SAUNDERS, M. L., P & THORNHILL, A. 2009. Understanding research philosophies and approaches. *Research Methods for Business Students*, 4, 106-135.
- SCHIFFERDECKER, K. E. & REED, V. A. 2009. Using mixed methods research in medical education: basic guidelines for researchers. *Medical Education*, 43, 637-44.
- SCHMIDT, H. & BOSHUIZEN, H. 1993a. On acquiring expertise in medicine. *Educational Psychology Review*, 5, 205-221.
- SCHMIDT, H. & BOSHUIZEN, H. 1993b. On the origin of intermediate effects in clinical case recall. *Memory and Cognition*, 21, 338-351.
- SCHMIDT, H. G. & MAMEDE, S. 2015. How to improve the teaching of clinical reasoning: a narrative review and a proposal. *Medical Education*, 49, 961-73.
- SCHMIDT, H. G., NORMAN, G. R. & BOSHUIZEN, H. P. 1990. A cognitive perspective on medical expertise: theory and implication. *Academic Medicine*, 65, 611-21.
- SCHMIDT, H. G. & RIKERS, R. M. J. P. 2007. How expertise develops in medicine: knowledge encapsulation and illness script formation. *Medical Education*, 41, 1133-1139.
- SCHNEIDER, A., LÖWE, B., BARIE, S., JOOS, S., ENGESER, P. & SZECSENYI, J. 2010. How do primary care doctors deal with uncertainty in making diagnostic decisions? *Journal of Evaluation in Clinical Practice*, 16, 431-437.
- SCHNEIDER, A., WÜBKEN, M., LINDE, K. & BÜHNER, M. 2014. Communicating and Dealing with Uncertainty in General Practice: The Association with Neuroticism (Dealing with Uncertainty). *PLoS One*, 9, e102780.
- SCHUTZ, A. 1972. *The Phenomenology of the Social World*. London: Heinemann.
- SCHWIEBERT, P., CACY, D., DAVIS, A. & CRANDALL, S. 2009. Using narrative student feedback to evaluate the impact of a family medicine clerkship. *Teaching and Learning in Medicine*, 8:3, 158-163.

- SCHWIND, C. J., BOEHLER, M. L., MARKWELL, S. J., WILLIAMS, R. G. & BRENNER, M. J. 2011. Use of simulated pages to prepare medical students for internship and improve patient safety. *Academic Medicine*, 86, 77-84.
- SHAH, K. 2001. Research in brief: what do medical students know about autism? *Autism*, 5, 12733.
- SHAW, R. L. 2010. Embedding reflexivity within experiential qualitative psychology. *Qualitative Research in Psychology*, 7, 233-243.
- SILVA, A. & SILVA, S. 2013. *Clinical reasoning development in medical students: an educational transcultural comparative study*. PhD Thesis, University of Nottingham.
- SILVA, A. L. 2013. *Clinical reasoning development in medical students: an educational transcultural comparative study*. PhD Thesis, University of Nottingham.
- SILVERMAN, J., DEVEUGELE, M., DE HAES, H. & ROSENBAUM, M. 2011. Unskilled creativity is counterproductive. *Medical Education*, 45, 959-60; author reply 961-2.
- SIM, J. H., ABDUL AZIZ, Y. F., MANSOR, A., VIJAYANANTHAN, A., FOONG, C. C. & VADIVELU, J. 2015. Students' performance in the different clinical skills assessed in OSCE: what does it reveal? *Medical Education Online*, 20, 26185.
- SINGH, H., THOMAS, E. J., KHAN, M. M. & PETERSEN, L. A. 2007. Identifying diagnostic errors in primary care using an electronic screening algorithm. *Archives of Internal Medicine*, 167, 302-8.
- SISSON, C., J, DONNELLY, B., M & WOOLLISCROFT, O., J 1991. The characteristics of early diagnostic hypotheses generated by physicians (experts) and students (novices) at one medical school. *Academic Medicine*, 66, 607-12.
- SLOMAN, S. A. 1996. The Empirical Case for Two Systems of Reasoning. *Psychological Bulletin*, 119, 3-22.
- SMITH, C. S., HILL, W., FRANCOVICH, C., MORRIS, M., ROBBINS, B., ROBINS, L. & TURNER, A. 2014. Diagnostic Reasoning across the Medical Education Continuum. *Healthcare (Basel, Switzerland)*, 2, 253-71.
- SMITH, J. 2015a. *The Transition from Final Year Medical Student to Foundation Doctor: The Clinical Reasoning Journey*. Doctor of Philosophy, University of Dundee.
- SMITH, J. A. 2007. Hermeneutics, human sciences and health: linking theory and practice. *International Journal of Qualitative Studies on Health and Well-Being*, 2, 3-11.
- SMITH, J. A. 2015b. *Qualitative psychology: a practical guide to research methods*, London, London: SAGE.
- SMITH, J. A., FLOWERS, P. & LARKING, M. 2009. *Interpretative Phenomenological Analysis: Theory, Method, and Research*, London, SAGE Publications Ltd.
- SMITH, J. A., MICHIE, S., STEPHENSON, M. & QUARRELL, O. 2002. Risk Perception and Decision-making Processes in Candidates for Genetic Testing for Huntington's Disease: An Interpretative Phenomenological Analysis. *Journal of Health Psychology*, 7, 131-44.
- SMITH, J. A. & OSBORN, M. 2003. Interpretative Phenomenological Analysis. In: SMITH, J. A. (ed.) *Qualitative Psychology: A Practical Guide to Methods*. London: Sage.
- SMITH, L. B. & THELEN, E. 2003. Development as a dynamic system. *Trends in cognitive sciences*, 7, 343-348.
- STALMEIJER, R. E. 2015. When I say ... cognitive apprenticeship. *Medical Education*, 49, 355-356.
- STALMEIJER, R. E., DOLMANS, D. H., WOLFHAGEN, I. H. & SCHERPBIER, A. J. 2009. Cognitive apprenticeship in clinical practice: can it stimulate learning in the opinion of students? *Advances in Health Science Education: Theory and Practice*, 14, 535-46.
- STERN, S. D. C., CIFU, A. S. & ALTKORN, D. 2015. *Symptom to Diagnosis: An Evidence-Based Guide*, New York, NY, McGraw-Hill Education.
- STRAUSS, W. & HOWE, N. 2000. *Millennials rising: the next great generation*, NY, Vintage Books.
- STYLE, A. 1979. Intuition and problem solving. *The Journal of the Royal College of General Practitioners*, 29, 71-4.
- SVENBERG, K., WAHLQVIST, M. & MATTSSON, B. 2007. "A memorable consultation": writing reflective accounts articulates students' learning in general practice. *Scandinavian Journal of Primary Health Care*, 25, 75-9.
- SWANSON, D. B. & VAN DER VLEUTEN, C. P. 2013. Assessment of clinical skills with standardized patients: state of the art revisited. *Teach Learn Med*, 25 Suppl 1, S17-25.

- SWELLER, J. 1988. Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12, 257-285.
- TASHAKKORI, A. & TEDDLIE, C. 1998. *Mixed Methodology: Combining Qualitative and Quantitative Approaches*, SAGE Publications, Inc.
- TEHRANI, A. S. S., LEE, H., MATHEWS, S. C., SHORE, A., MAKARY, M. A., PRONOVOST, P. J. & NEWMAN-TOKER, D. E. 2013. 25-Year summary of US malpractice claims for diagnostic errors 1986-2010: an analysis from the National Practitioner Data Bank. *BMJ Quality and Safety*, 22, 672-80.
- TEUNISSEN, P. W. & WESTERMAN, M. 2011a. Junior doctors caught in the clash: the transition from learning to working explored. *Medical Education*, 45, 968-970.
- TEUNISSEN, P. W. & WESTERMAN, M. 2011b. Opportunity or threat: the ambiguity of the consequences of transitions in medical education. *Medical Education*, 45, 51-9.
- THAMMASITBOON, S. & CUTRER, W. B. 2013. Diagnostic decision-making and strategies to improve diagnosis. *Current Problems in Pediatric and Adolescent Health Care*, 43, 232-41.
- THAMMASITBOON, S. & SINGHAL, G. 2013. Diagnosing diagnostic error. *Current Problems in Pediatric and Adolescent Health Care*, 43, 227-31.
- THE KING'S FUND. 2014. *Medical workforce* [Online]. Available: <https://www.kingsfund.org.uk/projects/time-think-differently/trends-workforce-medical> [Accessed 19.04.2018].
- THIERRY, P., JACQUES, T., EMMANUEL, T. & BERNARD, C. 2011. An analysis of clinical reasoning through a recent and comprehensive approach: the dual-process theory. *Medical Education Online*, 16, 10.3402/meo.v16i0.5890.
- TREICHLER, P., FRANKEL, R., KRAMARAE, C., ZOPPI, K. & BECKMAN, H. 1984. Problems and problems: power relationships in a medical encounter. In: KRAMARAE, C., SCHULZ, M. & O'BARR, W. M. (eds.) *Language and Power*. Beverly Hills: Sage.
- TRINDER, L. & REYNOLDS, S. 2001. *Evidence-based practice: a critical appraisal*, Oxford, Oxford : Blackwell Science.
- TUCKMANN, E., CHAPPLE, P., FRANKEIN, L., MANSER, I., WOODALL, J., RANDALL, K. & MCDONALD, J. 1962. Acute gastrointestinal illness in general practice. *British Medical Journal*, 1, 135-41.
- TURNER, M. K., SIMON, S. R., FACEMYER, K. C., NEWHALL, L. M. & VEACH, T. L. 2006. Web-based learning versus standardized patients for teaching clinical diagnosis: a randomized, controlled, crossover trial. *Teaching and Learning in Medicine*, 18, 208-14.
- TWENGE, J. M. 2009. Generational changes and their impact in the classroom: teaching Generation Me. *Medical Education*, 43, 398-405.
- VAISMORADI, M., TURUNEN, H. & BONDAS, T. 2013. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Sciences*, 15, 398-405.
- VAJER, P., SZELVARI, A., VOROS, K., TORZSA, P., EORY, A., DUNAI, K., TAMAS, F. & KALABAY, L. 2010. Comparative analysis of diagnostic probability estimates of some common diagnoses among family doctors, medical residents, and medical students reveals negative correlation between age and estimate of chronic obstructive pulmonary disease (COPD). *Medical Science Monitor*, 16, 109-115.
- VAN DEN BERGE, K. & MAMEDE, S. 2013. Cognitive diagnostic error in internal medicine. *European Journal of Internal Medicine*, 24, 525-9.
- VAN MANEN, M. 1997. *Researching lived experience: Human science for an action sensitive pedagogy*, London, The Althouse Press.
- VAN MERRIËNBOER, J. J. & SWELLER, J. 2010. Cognitive load theory in health professional education: design principles and strategies. *Medical Education*, 44, 85-93.
- VAN WEEL-BAUMGARTEN, E., BOLHUIS, S., ROSENBAUM, M. & SILVERMAN, J. 2013. Bridging the gap: How is integrating communication skills with medical content throughout the curriculum valued by students? *Patient Education and Counseling*, 90, 177-83.
- WADE, D. T. & HALLIGAN, P. W. 2004. Do biomedical models of illness make for good healthcare systems? *BMJ*, 329, 1398-401.

- WALZMAN, M., ALLEN, M. & WALL, D. 2015. General Practice and the Foundation Programme: The View of Foundation Year Two Doctors from the Coventry and Warwickshire Foundation School. *Education for Primary Care*, 19, 151-159.
- WASSON, J. H., SOX, H. C. & SOX, C. H. 1981. The diagnosis of abdominal pain in ambulatory male patients. *Medical Decision Making*, 1, 215-24.
- WATMOUGH, S., GARDEN, A. & TAYLOR, D. 2006. Pre-registration house officers' views on studying under a reformed medical curriculum in the UK. *Medical Education*, 40, 8939.
- WELLER, J. 2014. Oxford Textbook of Medical Education.
- WELLER, S. C. & DUNGY, C. I. 1986. Personal preferences and ethnic variations among Anglo and Hispanic breast and bottle feeders. *Social Science and Medicine*, 23, 539-48.
- WETHERELL, M., TAYLOR, S. & YATES, S. J. 2001. Discourse theory and practice: A reader. London: SAGE.
- WIGTON, R. S., PATIL, K. D. & HOELLERICH, V. L. 1986. The effect of feedback in learning clinical diagnosis. *Journal of Medical Education*, 61, 816-22.
- WIJNEN-MEIJER, M., TEN CATE, O. T., VAN DER SCHAAF, M. & BORLEFFS, J. C. 2010. Vertical integration in medical school: effect on the transition to postgraduate training. *Medical Education*, 44, 272-9.
- WILLIAMS, R. G., KLAMEN, D. L. & HOFFMAN, R. M. 2008. Medical student acquisition of clinical working knowledge. *Teaching and Learning in Medicine*, 20, 5-10.
- WILLIAMS, R. G., KLAMEN, D. L., WHITE, C. B., PETRUSA, E., FINCHER, R. M., WHITFIELD, C. F., SHATZER, J. H., MCCARTY, T. & MILLER, B. M. 2011. Tracking development of clinical reasoning ability across five medical schools using a progress test. *Academic Medicine*, 86, 1148-54.
- WILLIAMSON, M., WALKER, T., EGAN, T., STORR, E., ROSS, J. & KENRICK, K. 2013. The Safe and Effective Clinical Outcomes (SECO) Clinic: Learning Responsibility for Patient Care through Simulation. *Teaching and Learning in Medicine*, 25, 155-158.
- WILLIG, C. 2001. *Introducing Qualitative research in Psychology: Adventures in theory and method*, Buckingham, Open University Press.
- WILLIG, C. 2009. *Introducing Qualitative Research in Psychology*. 2nd Ed. ed. Maidenhead, England: McGraw Hill/Open University.
- WIMMERS, P. F., SCHMIDT, H. G. & SPLINTER, T. A. 2006. Influence of clerkship experiences on clinical competence. *Medical Education*, 40, 450-8.
- WOOLGAR, S. 1988. *Knowledge and reflexivity*, London, Sage.
- YARDLEY, L. 2000. Dilemmas in qualitative health research. *Psychology & Health*, 15, 215-228.
- YOUNG, J. Q., VAN DIJK, S. M., O'SULLIVAN, P. S., CUSTERS, E. J., IRBY, D. M. & TEN CATE, O. 2016. Influence of learner knowledge and case complexity on handover accuracy and cognitive load: results from a simulation study. *Medical Education*, 50, 969-78.
- YOUNG, J. Q., VAN MERRIENBOER, J., DURNING, S. & TEN CATE, O. 2014. Cognitive Load Theory: implications for medical education: AMEE Guide No. 86. *Medical Teacher*, 36, 371-84.
- YOUNG, J. S., SMITH, R. L., GUERLAIN, S. & NOLLEY, B. 2007. How residents think and make medical decisions: implications for education and patient safety. *The American Surgeon*, 73, 548-53; discussion 553-4.
- ZACHARIADIS, M., SCOTT, S. & BARRETT, M. 2013. Methodological Implications of Critical Realism for Mixed-Methods Research. *MIS Quarterly*, 37, 855.
- ZIV, A., WOLPE, P. R., SMALL, S. D. & GLICK, S. 2003. Simulation-based medical education: an ethical imperative. *Academic Medicine*, 78, 783-8.

# 8 APPENDICES

## A. INTERVIEW GUIDE FOR THE VIDEO-STIMULATED INTERVIEWS

### Semi-structured interview guide



#### Before watching the video

1. How did you find the consultation?
2. How did you find being filmed during the consultation?

#### Instruction before watching the video footage:

*What I would like you to do is as we are watching the video is to try to remember what was going through your mind during the consultation. If you cannot remember what you were thinking or if you were thinking about something other than the consultation, either is okay.*

*As we are watching the video, when you can remember what was going through your mind, please pause the video, and tell me your thoughts. I may also stop the video at times and ask you to tell me what you were thinking.*

#### While watching the video

1. What was your first impression of the patient's problems after their initial comments?
2. What were you thinking at this point? / What was going through your mind here?
3. Did you think this at the time of the consultation? (checking for post-hoc rationalization)
4. What made you ask this question?
5. How did you arrive at this conclusion? What features of the patient's history allowed you to arrive to that conclusion?
6. What led you to make that diagnosis? Were there any other competing diagnoses that you have considered?

#### After watching the video

1. What do you think is the most challenging part of the diagnostic process?
2. How did you find reflecting upon the consultation?

## B. CONSENT FORM FOR MEDICAL STUDENTS IN PHASE 1

### CONSENT FORM



Title of Project: Can simulation clarify diagnostic skills for newly qualified doctors?

Name of Researcher: Annamaria Nagy

Please  
initial box

I confirm that I have read and understood the Participant Information Sheet for the study and I understand the procedures and possible risks. I have had the chance to ask questions about the study and I am satisfied with the answers I have been given.

I understand that my participation in this study is voluntary and that I am free to stop at any time, and I do not have to give a reason for doing so. I understand that there will be no negative consequences for this action.

I understand that my consultation with the simulated patient will be filmed and the interview afterwards will be recorded as well. I understand that I will be viewing the filmed consultation with the researcher during the interview and make reflective comments upon my reasoning and decision-making process.

I understand that relevant sections of the data collected during the study will be used for research purposes. I am aware that direct quotations from my simulation exercise and the following interview may be used in the study in an anonymised form. I give permission for my data to be used for this purpose.

I understand that occasionally an external regulator or funding body may ask to look at the data for this study to check that it is being run correctly.

I understand that if unprofessional behaviour is witnessed during the study, the researcher will have the duty to inform the Director of Undergraduate Teaching and Learning (Dr Juliet Wright).

I agree to take part in the above study.

\_\_\_\_\_  
Name of Participant                      Date              Signature

-----  
-- --

I have explained the information in this document and encouraged the participant to ask questions and provided adequate time to answer them.

\_\_\_\_\_  
Name of Researcher                      Date                      Signature  
or Person Seeking Consent  
(If different from researcher)

When completed: 1 copy for the participant; 1 copy for the researcher site file

## C. PARTICIPANT INFORMATION SHEET FOR PHASE 1

Dear Participant,



### *'Diagnostic reasoning in primary care'*

We would like to invite you to take part in our research study. Before you decide we would like you to understand why the research is being done and what it would involve for you if you took part. One of our team will go through the information with you and answer any questions you may have.

Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

#### **1. What is the purpose of the study?**

This study is undertaken as part of my PhD project at BSMS. The purpose of the project is to explore how medical students think during diagnostic consultations. The data obtained through the study could help to refine how diagnostic reasoning skills are taught at BSMS.

#### **2. Who is organising and funding the research?**

The research is funded by Brighton & Sussex Medical School.

#### **3. Why have I been invited?**

You have been invited for this study because you are a 4<sup>th</sup> year medical student at BSMS and you have indicated your interest in this research project.

#### **4. Do I have to take part?**

No. It is completely up to you to decide whether or not you wish to join the study. If you agree to take part, we will ask you to sign a consent form. Even after signing the consent form, you will be free to withdraw from the study at any time without giving a reason.

#### **5. What will happen to me if I take part?**

Simulated Surgery:

As part of your General Practice module (403), you will take part in a Simulated Surgery exercise. Your simulation exercise will take place as normal with the only addition being that it will be filmed.

After the Simulated Surgery:

You will be invited to have a discussion with the researcher to talk about what was going through your mind during the simulation exercise.

#### **6. What will I have to do?**

After your Simulated Surgery, you will be asked to join the researcher in a separate room, and talk about your experience of the consultation. The researcher will also ask you about your thoughts, ideas and thinking process during the consultation, and how you have arrived to your diagnostic decisions.

During the discussion you will be watching the video recording of your consultation in order to refresh the experience. Your discussion with the researcher also will be recorded for later transcription purposes. The discussion will take approximately 20-30 minutes.

#### **7. What are the possible benefits of taking part?**

You will have the chance to watch the video of your consultation and discuss your experience of the simulation exercise. Reflecting on your experience can help you become more aware of your own skills and thinking process, which may be beneficial for you.

**8. Are there any possible disadvantages or risks of taking part?**

Since the study is interview based, there are minimal risks involved. However, some may find that filming during the simulation exercise may add to the anxiety of the task.

**9. What about confidentiality?**

All the information collected during the course of the research will be kept strictly confidential. All data will be stored securely, and only the researcher and the project supervisors (Prof Gordon Ferns and Dr Wesley Scott-Smith) will have access to it.

Due to the nature of the study, direct quotations from your consultation and interview may be used in the study. However, those quotes will be anonymised.

**10. What will happen if I don't want to carry on with the study?**

You are free to withdraw at any time and without giving a reason. You will not be penalized in any way and it will not affect your education at BSMS. We will also be happy to discuss with you what will happen to any data that has been collected up to the point of your withdrawal from the study.

**11. What if there is a problem?**

If you have any concerns about any aspect of this study or complaints about the way you have been treated during the study or possible harm you might suffer, you should ask to speak with the researchers who will do their best to answer your questions. The researchers contact details are provided at the end of this Sheet. However, it is not expected that any problems will occur.

**12. Harm**

The Universities of Brighton and Sussex have insurance in place to cover their legal liabilities in respect of this study.

**13. What will happen to the results of the research study?**

The study will be written and up and form part of my PhD thesis. The results may also be submitted for publication in relevant scientific journals and presented at academic conferences. A summary of the results will be made available for all participants.

**14. Who has approved this study?**

This study has received ethical approval from *the Brighton and Sussex Medical School Research Governance and Ethics Committee (BSMS RGEC)*.

**Thank you for taking the time to read this information sheet.**



## **E. PARTICIPANT INFORMATION SHEET FOR MEDICAL STUDENTS AND FOUNDATION TRAINEES IN PHASE 2 AND PHASE 3**

**Dear Participant,**



### **‘Diagnostic reasoning in primary care’**

We would like to invite you to take part in our research study. Before you decide we would like you to understand why the research is being done and what it would involve for you if you took part. One of our team will go through the information with you and answer any questions you may have.

Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

#### **1. What is the purpose of the study?**

This study is undertaken as part of my PhD project at Brighton & Sussex Medical School (BSMS). The purpose of the project is to explore how medical students think during diagnostic consultations. The data obtained through the study could help to refine how diagnostic reasoning skills are taught.

#### **2. Who is organising and funding the research?**

The research is funded by Brighton & Sussex Medical School.

#### **3. Why have I been invited?**

You have been invited for this study because you are a 5th year BSMS student or Foundation Year doctor, and you have indicated your interest in this project.

#### **4. Do I have to take part?**

No. It is completely up to you to decide whether or not you wish to join the study. If you agree to take part, we will ask you to sign a consent form. Even after signing the consent form, you will be free to withdraw from the study at any time without giving a reason.

#### **5. What will happen to me if I take part?**

Some of your diagnostic consultations (during student-led surgeries) will be filmed. Afterwards, you will be invited to have a discussion with the researcher to talk about what was going through your mind during the consultation.

#### **6. What will I have to do?**

After your filmed consultation, you will be asked to join the researcher in a separate room, and talk about your experience of the consultation. The researcher will also ask you about your thoughts, ideas and thinking process during the consultation, and how you have arrived to your diagnostic decisions.

During the discussion you will be watching the video recording of your consultation in order to refresh the experience. Your discussion with the researcher will be recorded as well, and take approximately 30 minutes.

#### **7. What are the possible benefits of taking part?**

You will have the chance to discuss your experience of your consultation. Reflecting on your experience can help you become more aware of your own skills and thinking process, which may be beneficial for you.

#### **8. Are there any possible disadvantages or risks of taking part?**

Since the study is interview based, there are minimal risks involved. However, some may find that filming may add to the anxiety of the task.

#### **9. What about confidentiality?**

All the information collected during the course of the research will be kept strictly confidential. All data will be stored securely, and only the researcher and the project supervisors will have access to it.

Due to the nature of the study, direct quotations from your consultation and interview may be used in the study in an anonymised form.

In certain exceptional circumstances where you or others may be at significant risk of harm, the researcher

may need to report this to an appropriate authority, in accordance with the UK Data Protection Act 1998. This would usually be discussed with you first. The researcher may disclose identifiable information without consent if it is required by law, if it is approved under section 251 of the NHS Act 2006.

**10. What will happen if I don't want to carry on with the study?**

You are free to withdraw at any time and without giving a reason. You will not be penalized in any way and it will not affect your education at BSMS. We will also be happy to discuss with you what will happen to any data that has been collected up to the point of your withdrawal from the study.

**11. What if there is a problem?**

If you have any concerns about any aspect of this study or complaints about the way you have been treated during the study or possible harm you might suffer, you should ask to speak with the researchers who will do their best to answer your questions. The researchers contact details are provided at the end of this Sheet. However, it is not expected that any problems will occur.

If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the GP or the local Clinical Commissioning Group. In the event that something does go wrong and you are harmed during the research and this is due to someone's negligence, then you may have grounds for a legal action for compensation against the NHS but you may have to pay your legal costs. The normal National Health Service complaints mechanisms will still be available to you.

**12. Harm**

The Universities of Brighton and Sussex have insurance in place to cover their legal liabilities in respect of this study.

**13. What will happen to the results of the research study?**

The study will be written up and form part of my PhD thesis. The results may also be submitted for publication in relevant scientific journals and presented at academic conferences. A summary of the results will be made available for all participants.

**14. Who has approved this study?**

All research in the NHS is looked at by an independent group of people, called a Research Ethics Committee to protect your safety, rights, well-being and dignity. This study has been reviewed and given favourable opinion by East of England - Cambridgeshire and Hertfordshire Research Ethics Committee via Proportionate Review Service.

**Thank you for taking the time to read this information sheet.**

F. PATIENT CONSENT FORM FOR PHASE 2 AND PHASE 3

**Patient Consent Form for Video Recording  
for Research Purposes\***



Patient's name:

Place of Video Recording:

Date:

Dear patient

We hope to make a video recording of the consultation between yourself and the final year medical student/ junior doctor whom you are seeing today. The video will be used to review the consultation with the medical students/junior doctors in order to help understand how they make diagnostic decisions.

The video recording will ONLY be of you and the doctor talking together during the consultation. Intimate examinations will not be recorded and the camera will be switched off on request. The video will be stored securely in accordance with NHS guidelines, and will be erased within one year of completion of the research study.

**You do not have to agree to your consultation with the doctor being recorded.** If you want the camera to be turned off at any time, please tell your doctor - this is not a problem, and will not affect your consultation in any way. But if you do not mind your consultation being recorded, please sign below.

**Thank you very much for your help.**

**TO BE COMPLETED BY PATIENT**

**I have read and understood the above information and give my permission for my consultation to be video recorded.**

Signature of patient **BEFORE CONSULTATION:**

..... Date .....

**After seeing the doctor I am still willing/I no longer wish my consultation to be used for the above purposes.**

Signature of patient **AFTER CONSULTATION:**

..... Date .....

\* Adapted from the *Patient Consent Form for Video/Digital Recording for Training Purposes* by the Royal College of General Practitioners

**G. PATIENT INFORMATION SHEET FOR PHASE 2 AND PHASE 3**



**Dear Patient,**

We would like to invite you to take part in our **research study on Diagnostic Reasoning in primary care.**

You may be eligible for this study if you are over 18, not dependent upon a carer for communication purposes, and clearly understand the participation leaflet.

If you are interested in learning more about this study, please review the information attached, sign the enclosed consent form, and return it to your GP at the start of your consultation.

**Your participation would be greatly appreciated!**

**Thank you for your time.**

**Sincerely,**

**Annamaria Nagy  
PhD student at Brighton and Sussex Medical School**



Dear Patient,

We would like to invite you to take part in our research study. Before you decide we would like you to understand why the research is being done and what it would involve for you if you took part. If you would require so, one of our team will go through the information with you and answer any questions you may have. Talk to others about the study if you wish. Ask us if there is anything that is unclear or if you would like more information. Take your time in deciding whether or not you wish to take part.

**1. What is the purpose of the study?**

This study is undertaken as part of the researcher's PhD project at Brighton and Sussex Medical School. The purpose of the project is to explore how medical students and junior doctors think during diagnostic consultations. The information obtained through the study could help to refine how diagnostic skills are understood and taught.

**2. Who is organising and funding the research?**

The research is funded by Brighton & Sussex Medical School.

**3. Why have I been invited?**

You have been invited for this study because you are a patient at this practice about to have a consultation with a final year medical student or junior doctor.

**4. Do I have to take part?**

No. It is completely up to you to decide whether or not you wish to join the study.

**5. What will happen to me if I take part?**

If you agree to take part in the study, you will be asked to sign and date the Informed Consent Form attached. You will be assigned a unique participant number that will be used to make sure you cannot be identified outside the study. All information, which is collected, about you during the course of the research will be treated as strictly confidential.

After signing the consent form, your GP consultation will be filmed. The video recording is ONLY of you and the doctor talking together. Intimate examinations will not be recorded and the camera will be switched off on request at any time during the consultation. After the consultation, you will be asked to sign the consent form again.

Once the consultation is over, the medical student/junior doctor who was with you will watch the video of the consultation with the researcher in order to help them reflect upon their own diagnostic thinking, and decision-making process.

**6. What will I have to do?**

You will need to sign the Informed Consent Form before your consultation today, and then simply attend your consultation as usual. After the consultation, your doctor will ask you again whether you are still willing to take part in our study, and if so, you will be asked to sign the Informed Consent Form one more time.

**7. What are the possible benefits of taking part?**

There are no known benefits from taking part in.

**8. Are there any possible disadvantages or risks of taking part?**

There are no disadvantages or risks involved.

**9. What about confidentiality?**

All the information collected during the course of the research will be kept strictly confidential. All data will be stored securely, and only the researcher and the project supervisors will have access to it. Due to the nature of the study, direct quotations from your consultation may be used in the study in an anonymised form.

In certain exceptional circumstances where you or others may be at significant risk of harm, the researcher may need to report this to an appropriate authority, in accordance with the UK Data Protection Act 1998. This would usually be discussed with you first. The researcher may disclose identifiable information without consent if it is required by law, if it is approved under section 251 of the NHS Act 2006.

**10. What will happen if I don't want to carry on with the study?**

Your participation in this study is voluntary. If you change your mind about participating and wish to withdraw from the study, you may do so at any time without giving a reason. In this case, please, let your doctor know and the camera will be switched off immediately, and the video footage will be erased. This decision will not affect the standard of your future care in any way. If, after leaving the building, you would prefer that your videotape is not used, please contact the GP receptionist or your doctor within 7 days, and we will ensure that your consultation is erased from the tape.

**11. What if there is a problem?**

If you have any concerns about any aspect of this study or complaints about the way you have been treated during the study or possible harm you might suffer, you should ask to speak with the researchers who will do their best to answer your questions. The researchers contact details are provided at the end of this Sheet. However, it is not expected that any problems will occur.

If you remain unhappy and wish to complain formally, you can do this through the NHS Complaints Procedure. Details can be obtained from the GP or the local Clinical Commissioning Group. In the event that something does go wrong and you are harmed during the research and this is due to someone's negligence, then you may have grounds for a legal action for compensation against the NHS but you may have to pay your legal costs. The normal National Health Service complaints mechanisms will still be available to you.

**12. Harm**

The Universities of Brighton and Sussex have insurance in place to cover their legal liabilities in respect of this study.

**13. What will happen to the results of the research study?**

The study will be written up and form part of the researcher's PhD thesis. The results may also be submitted for publication in relevant scientific journals and presented at academic conferences. A summary of the results will be made available for all participants.

**14. Who has approved this study?**

All research in the NHS is looked at by an independent group of people, called a Research Ethics Committee to protect your safety, rights, well-being and dignity. This study has been reviewed and given favourable opinion by East of England - Cambridgeshire and Hertfordshire Research Ethics Committee via Proportionate Review Service.

**15. What if I have further questions?**

In case you have any questions or concerns about our research study that you would like to discuss today, please, ask the reception staff at the practice and they will direct you to the researcher who is present at the GP practice.

Thank you for taking the time to read this information sheet.



## I. ONLINE QUESTIONNAIRE FOR PHASE 4

### Questionnaire

#### *How do medical students use their diagnostic skills during Objective Structured Clinical Examinations and primary care consultations?*

##### **Instructions**

Welcome to this questionnaire exploring your experiences with OSCEs and GP consultations. You have been asked to complete the survey as you are currently a penultimate or final year medical student of one of the UK medical schools, and your views are being sought.

##### **Background**

Sound diagnostic skills are at the heart of medical practice. Yet, there is very little known about how medical students approaching the graduation use their diagnostic skills in different settings. In this survey we would like to explore two things: (1) your experiences with OSCEs from a diagnostic perspective, (2) your experiences with diagnostic GP consultations.

##### **Prize-draw**

If you wish, you have the opportunity to be entered into a **prize-draw to win £100**. In order to enter the draw you will need to provide your name and contact details. These details will **ONLY** be used for the purposes of the draw. If you do not wish to enter the draw please leave this section blank.

##### **About completing the survey**

This survey should take you approximately **5 minutes** to complete. All questions are mandatory. All information collected is treated confidentially and processed anonymously. Note that once you have clicked on the CONTINUE button at the bottom of each page you cannot return to review or amend that page.

Please do not hesitate to contact me should you require further information or assistance in completing the survey. Contact details: Annamaria Nagy - PhD Candidate at Brighton and Sussex Medical School, Medical Education Unit, Mayfield House, Falmer, email address: [a.nagy@bsms.ac.uk](mailto:a.nagy@bsms.ac.uk)

##### **Data Protection Statement**

The survey is completed anonymously. All data collected in this survey will be held anonymously and securely. The responses that you provide will not be identifiable to you in any way, and will not be available to your medical school. Participation is completely voluntary. **If you decide to complete and submit the questionnaire you are consenting to participate in this study.** You are free to withdraw from the study at any point without having to provide a reason, and you can ask for your data to be destroyed/removed from the study. However, it is no longer possible to withdraw from the study once the results have been written up in the PhD thesis or any other publications. The results will be collated to explore how medical students across the country apply their diagnostic skills in different settings and to inform current assessment and training. In addition, the results will be used to form part of my PhD thesis. Findings may also be submitted to a peer reviewed journals for publication, and to relevant conferences for presentation.

**SUBMIT AND CONTINUE button**

**“About you”**

The following questions will ask you about your age, medical school and what year of the undergraduate program you are currently in. We ask these questions are for demographic purposes only and your answers will be completely anonymous.

1. Which UK Medical School do you study at?  
\_\_\_\_\_
2. What year of the undergraduate program are you currently in?  
 Penultimate year  
 Final year
3. What is your age?  
\_\_\_\_\_

**Part 1 “OSCEs”**

We would like to explore your experiences with Objective Structured Clinical Evaluations (OSCEs). We would like you to think back to your latest OSCE experience and answer the following questions. Please, give your honest opinions as the answers are kept strictly confidential.

1. What is the first thing that comes to mind when you think of OSCEs?  
\_\_\_\_\_
2. Please indicate how much each of the following statements characterizes your approach during OSCEs.
  - a. I ask questions during the OSCE that I would NOT ask in a real clinical situation  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - b. Even if I don’t understand anything that is going on, I pretend that I do  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - c. I keep asking questions to pretend that I know what I am doing  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - d. I try to guess what is on the assessment/examination checklist while completing a station  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - e. When I think a question is on the evaluation checklist, I will ask that question even if I don’t it is necessary for my diagnosis  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - f. I focus on what to ask next, so I miss parts of what the patient is saying  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - g. I use mnemonic devices during history taking (e.g. the SOCRATES for pain assessment)  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - h. I have enough time to think through the problems critically during OSCE stations  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
  - i. Trying to memorize station checklists is part of my OSCE preparation  

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------
3. Please indicate how much you agree or disagree with each of the following statements.
  - a. My thinking process during an OSCE station resembles my thinking process during solving real clinical problems  

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--
  - b. OSCEs test my diagnostic reasoning skills  

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

c. During OSCEs I ask questions to tick boxes on the assessment/examination checklist

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

d. I don't want to leave moments of silence, because it makes it look like I don't know what I am doing

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

e. I am going through the same structured history each time

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

f. I find it difficult to think about the diagnosis and listen to the patient at the same time

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

g. OSCEs are good opportunity for critical thinking

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

h. OSCEs test the fact that I have memorized all the different stations

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

### **Part 2 "Primary care"**

Now we would like to explore your experiences with primary care consultations. We would like you to think back to the primary care experiences you have had during your training and answer the following questions. Please, give your honest opinions as the answers are kept strictly confidential.

1. What do you find most challenging about the diagnostic process in primary care?  
\_\_\_\_\_
2. In your view, how is the diagnostic process in primary care different from secondary care?  
\_\_\_\_\_
3. Finally, we would like you to think about your experiences with **primary care consultations**. Please indicate how much you agree or disagree with each of the following statements.

a. During primary care consultations, I am going through the same structured history each time

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

b. During primary care consultations, I don't want to leave moments of silence, because it makes it look like I don't know what I am doing

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

c. I admit when I don't know something during the consultation

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

d. I ask all the questions that I would at an OSCE station with a similar case

Strongly Agree <input type="checkbox"/>	Agree <input type="checkbox"/>	Slightly agree <input type="checkbox"/>	Slightly disagree <input type="checkbox"/>	Disagree <input type="checkbox"/>	Strongly disagree <input type="checkbox"/>
---	--------------------------------	---	--	-----------------------------------	--

4. Please indicate how much each of the following statements characterizes your approach during primary care consultations.
  - a. I use mnemonic devices during history taking (e.g. the SOCRATES for pain assessment)

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------

b. Even if I don't understand anything that is going on, I pretend that I do

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------

d. I have enough time to think through the problem critically during primary care consultations

Always <input type="checkbox"/>	Often <input type="checkbox"/>	Occasionally <input type="checkbox"/>	Rarely <input type="checkbox"/>	Very Rarely <input type="checkbox"/>	Never <input type="checkbox"/>
---------------------------------	--------------------------------	---------------------------------------	---------------------------------	--------------------------------------	--------------------------------

**Feedback & Prize-draw**

Thank you for answering our questions. Please give some feedback about your survey experience:

Did you find the questions easy to understand?

- a. Yes
- b. No

Do you have any additional comments?

- a. No
- b. Other \_\_\_\_\_

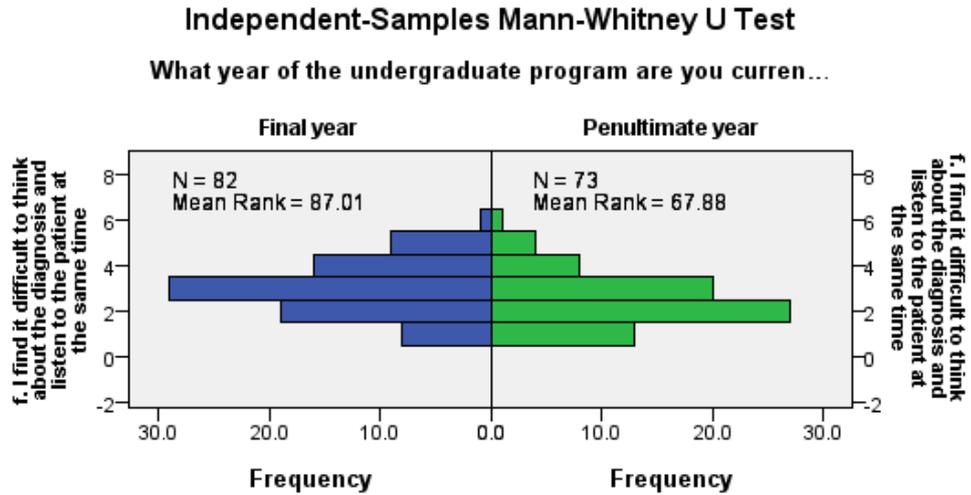
THANK YOU FOR COMPLETING THE SURVEY!

## J. SURVEY QUESTIONS ORGANIZED INTO THEMES

<p><b>OSCE versus real life</b></p>	<ol style="list-style-type: none"> <li>1. My thinking process during an OSCE station resembles my thinking process during solving real clinical problems</li> <li>2. I ask questions during the OSCE that I would NOT ask in a real clinical situation</li> <li>3. When I think a question is on the evaluation checklist, I will ask that question even if I don't it is necessary for my diagnosis</li> <li>4. I ask all the questions [during primary care consultations] that I would at an OSCE station with a similar case</li> </ol>
<p><b>Pretended competence</b></p>	<ol style="list-style-type: none"> <li>1. I don't want to leave moments of silence, because it makes it look like I don't know what I am doing [during OSCE stations]</li> <li>2. I keep asking questions to pretend that I know what I am doing [during OSCE stations]</li> <li>3. Even if I don't understand anything that is going on, I pretend that I do [during OSCE stations]</li> <li>4. During primary care consultations, I don't want to leave moments of silence, because it makes it look like I don't know what I am doing</li> <li>5. Even if I don't understand anything that is going on, I pretend that I do [during primary care consultations]</li> <li>6. I admit when I don't know something during the consultation [during primary care consultations]</li> </ol>
<p><b>Focusing on the assessment checklist</b></p>	<ol style="list-style-type: none"> <li>1. During OSCEs I ask questions to tick boxes on the examination checklist</li> <li>2. I try to guess what is on the examination checklist while completing an OSCE station</li> </ol>
<p><b>Structured approach</b></p>	<ol style="list-style-type: none"> <li>1. I am going through the same structured history each time [during OSCE stations]</li> <li>2. I use mnemonic devices during history taking (e.g. the SOCRATES for pain assessment) [during OSCE stations]</li> <li>3. During primary care consultations, I am going through the same structured history each time</li> <li>4. I use mnemonic devices during history taking (e.g. the SOCRATES for pain assessment) [during primary care consultations]</li> </ol>
<p><b>Thinking, listening and talking</b></p>	<ol style="list-style-type: none"> <li>1. I find it difficult to think about the diagnosis and listen to the patient at the same time [during OSCE stations]</li> <li>2. I focus on what to ask next, so I miss parts of what the patient is saying [during OSCE stations]</li> <li>3. I focus on what questions to ask next, so I miss parts of what the patient is saying [during primary care consultations]</li> </ol>
<p><b>OSCE and diagnostic reasoning</b></p>	<ol style="list-style-type: none"> <li>1. OSCEs are good opportunity for critical thinking</li> <li>2. OSCEs test my diagnostic reasoning skills</li> </ol>
<p><b>Memorized checklists</b></p>	<ol style="list-style-type: none"> <li>1. OSCEs test the fact that I have memorized all the different stations</li> <li>2. Trying to memorize station checklists is part of my OSCE preparation</li> </ol>
<p><b>Time pressure</b></p>	<ol style="list-style-type: none"> <li>1. I have enough time to think through the problems critically during OSCE stations</li> <li>2. I have enough time to think through the problem critically during primary care consultations</li> </ol>

## K. INDEPENDENT-SAMPLES MANN-WHITNEY U TESTS

Null Hypothesis: The distribution of "During OSCEs, I find it difficult to think about the diagnosis and listen to the patient at the same time" is the same across categories of 'What year of the undergraduate program are you currently in?'

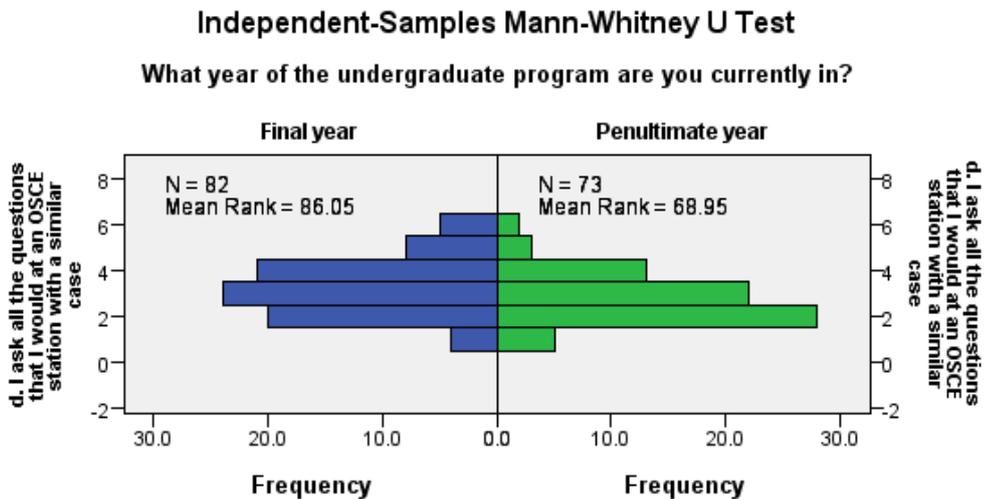


Independent-Samples Mann-Whitney U Test

Significance: 0.006

Decision: Reject the null hypothesis

Null Hypothesis: The distribution of "During primary care consultations, I ask all the questions that I would at an OSCE station with a similar case" is the same across categories of 'What year of the undergraduate program are you currently in?'



Independent-Samples Mann-Whitney U Test

Significance: 0.014

Decision: Reject the null hypothesis