Developing Clinical Competence

Studies in Professionalism and Diagnostic Reasoning

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Studies in Professionalism and Diagnostic Reasoning

Ontwikkeling van klinische competentie
Studies naar professionaliteit en diagnostisch redeneren

Thesis

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Chapter 1

Introduction to the thesis

This thesis deals with two main themes related to improving teaching and learning of medical students: professionalism and clinical reasoning. These two concepts are inter-related and cross-cutting in medical education. Professionalism is defined as the means by which individual doctors fulfill the medical profession's contract with society.[1] It is a vocation or calling and implies service to others with particular ethical principles and attributes.[2] Whereas clinical reasoning is defined as a diagnostic process including generation of hypotheses, hypotheses refinement through data gathering and interpretation, and diagnosis verification.[3] Both the development of professionalism and clinical reasoning in students, have been indicated to be essential for high-quality patient care and safe practice. In addition, professionalism attributes and clinical reasoning skills are partly overlapping; for example, treating a patient with respect improves patient-doctor communication, and enables the physician to collect more relevant information about the patient's problem, potentially improving diagnosis. Improving the clinical reasoning of physicians and medical students is found to reduce diagnostic errors in several studies.[4]
In this introduction both concepts will be discussed in more detail in relation to definition, historical perspectives, influencing factors and implementation in medical education. This discussion will be concluded by the research questions and objectives underlying the studies described in this thesis.

What is professionalism?

Professionalism has so far proven difficult to define despite several conceptual or methodological attempts.[5] This difficulty in providing a uniform definition of professionalism can at least in part be attributed to the fact that professionalism has different meaning for different people in different situations and context. As stated by Thistlethwaite "the word is full of nuance and as with words such as 'love' or 'quality', perhaps each of us is clear what we understand by the term, but we find it difficult to articulate."[2] This difficulty in articulation extends to the academic literature and to attempts to engage with professionalism as a theoretical construct complex and not concrete. Generally professionalism has been defined by many authors in terms of values such as definition by Calman[6] who identified 'key values' of practicing professional physicians, which may include high ethical standards, involvement in continuing professional development programs and ability to work in a team. Other definitions focus on observable and measurable behavior related to professionalism, from which the norms and values of the medical professional can be visualized.[7]
Professional Identity Formation (PIF) is considered as the most recent development in the field of professionalism. According to the concept (theory) of PIF, physicians internalize an identity that reflects choices of beliefs, commitments and characteristics of the self that are

conditioned by experiences in practice and continue to develop across the professional lifespan.[8] For example Swick's 'normative definition' of professionalism stresses elements of professionalism which may be seen as moral values (virtuous) rather than grounded in practice and role modeling from colleagues.[9] It represents the third side to the coin, each looking at professionalism from a different perspective.

This ambiguity in the definition of professionalism is problematic for medical education to some extent because it makes it challenging to adopt effective teaching strategies, as well as reliable and valid assessment methods. Nevertheless, it has recently been demonstrated that unprofessional behavior during medical education has an effect on later professional careers.[10] In a case-control study, investigators showed that students who exhibited unprofessional behavior in medical school were three times more likely to undergo disciplinary action by regulatory organizations during their later medical careers.[6] Furthermore, this study found that the behaviours involving "severe irresponsibility" and "diminished capacity for improvement" as medical students had an odds ratio of 8.5 and 3.1 respectively regarding subsequent disciplinary action as physicians.[6] So, despite acknowledged difficulties surrounding assessment of professionalism, this landmark study underscores the need to include the learning and teaching of professionalism in the medical curricula. In the next paragraphs, we will elaborate on the history of professionalism through different ages, learning and teaching, assessment, as well the factors that affect professionalism.

History of Professionalism

Hippocratic era

The term "medical professionalism" goes back to early 1990s in the United States as response to the pressing challenges of the healthcare system. However, the concepts and attributes of professionalism are older, and can be traced back to the era of Hippocrates. Hippocrates was an ancient Greek physician who was known to practice medicine with high level of moral values and ethics. One of his significant contributions to medicine was the so called "Hippocratic Oath". This oath was cited in its original or modified version for centuries by physicians upon entering medical practice.[2] This ancient oath has many elements that were and still are well aligned with the recent concept of medical professionalism. For example, "hold in highest regard one's teachers, and to renounce to recognize one's limitations" is aligned with respect and self-accountability respectively – Table 1.1.

Table 1.1 Alignment of the Hippocratic Oath elements with modern medical professionalism concepts.

Hippocratic Oath elements	Modern medical professionalism concepts
Hold in highest regard one's teachers, and to renounce	Respect
To recognize one's limitations	Self-accountability
Self-interest in the treatment of patients	Motivation and beneficence
Abstain from whatever is deleterious and mischievous	Non maleficence
Reckoning that all such should be kept secret	Confidentiality
Leave this to be done by men who are practitioners of this work	Expertise and teamwork

The Hippocratic Oath is historically taken by physicians as one of the most widely known of Greek medical texts. In its original form, it requires a new physician to swear, to uphold specific ethical standards, The Oath is the earliest expression of medical ethics in the Western world, establishing several principles of medical ethics which remain of paramount significance today (Wikipedia 2018).[11]

Islamic era

The period following the Hippocratic era which witnessed a significant development of medical ethics and professionalism, was the golden period of the Islamic Empire between the 8th and 14th century.[12] In this era, the development of Islamic medicine passed through three distinct phases.[13] First, a translation phase in which knowledge developed by others were imported into Arabic sources (7th-9th centuries); Second, a phase in which Islamic scientists were leading and were the main source of new knowledge to medicine (9th-13th centuries); and finally a last phase characterized by decline and translation of Arabic knowledge into Latin languages (13th century).[13]

The Arabic language was the language of science during medieval times as indicated by Lawrence I Conrad, in the book "Companion Encyclopedia of the History of Medicine".[14] "The language of the Arabs became the common cultural denominator of the medieval Middle East and was spoken as the lingua Franca by not only Muslims, but Christians and Jews as well".[14] A prominent example of this contribution is a medical book in five volumes titled "Al Qanoun fi Al Tib" ("Canon") written by a scientist and physician, Abu Ali al-Husayn ibn Abdallah ibn Sina (also known as Avicenna, 973-1037 AD). This book is a one-million-word encyclopedia covering medicine as whole[15] and was later translated into several other languages that was considered as main reference for European medical schools up to the seventeenth century.[16] The books of Avicenna presented moral and ethical advices on clinical practice of physicians. Table 1.2 provides an overview of the contribution of Avicenna and other scholars to medical ethics and the corresponding professional attributes.

Table 1.2 Contribution of Avicenna and other Arab scholars to medical ethics.

Period	Influential scholar	Book title	Professionalism attributes
(807-861 AD)	Abu Al-Hasan Abu al-Hasan Ali ibn Sahl Rabban al-Tabari	The Paradise of Wisdom" (*Ferdous al Hekmat*)	personal characters of physician, obligation towards patients, community, colleagues, and assistants
(865-925 AD)	Mohammad ibn Zakariya al-Razi	Inclusive Work on Medicine" (*al-Hawi fi al-Tib*) Mansurian Book of Medicine" (*al-Kitab al-Mansuri fi al-Tibb*)	Ethical principles in medicine self-accountability (*taqwa*) and self-motivation (*ehtesab*)
(973-1037 AD)	Abu Ali al-Husayn ibn Abdallah ibn Sina (Avicenna)	"Canon" (Al Qanon fi al Tibb	Principles of Medical Ethics Self-accountability Self-motivation
End of 9th century AD	Ishag ibn Ali al-Ruhawi	Ethics of Medicine (*Adab al Tabib*)	Loyalty of physicians, Responsibility, Ethical dilemmas in patient-Physician relationships, Manners of the visitors, Medical art for the people's moral Values, and harmful habits

Given the religious importance of moral virtues, Muslim physicians have put much emphasis on ethical principles in their practice. (Most of Muslim physicians would allocate part of their books on medical ethics. For thousands of years, ethics have been recognized as an essential requirement in the making of a physician.[17]

Medieval Era

Following the decline of Islamic Empire in the 13th century, knowledge was translated to Latin languages and formal medical education training started in universities. The first school of medicine of mediaeval times came into existence, probably in the ninth century, on the shores of the Tyrrhenian Sea, in the town of Salerno. The school was founded by representatives of the four cultural forces which had persisted through the Middle Ages-a Greek, a Latin, a Jew, and an Arab.[18] Graduates of these medical schools began to establish schools elsewhere in France, Spain, Portugal, and England; the earliest were those of Paris and Mont in the 12th century. During this time and until the 17th century medical education was using the apprenticeship model and was strongly influenced by religion.

One of the major milestones in the journey of medical professionalism development can be historically dated to medieval times when medical education as well as medical practice experienced clear development. This time witnessed the definition of ethical and social roles of physicians in the treatment and control of infectious diseases epidemics such as plague.[19] Following the medieval era, medical ethics continued to develop as distinctive definition during the Renaissance era which will be discussed in the next section.

Renaissance era and after

Medical ethics as distinctive definition was developed during the Renaissance era by Dr. Thomas Percival in 1803, who emphasize the unique social and ethical role for physicians. However, in that era , code of ethics was considered necessary only for physicians with misconduct.[20] Professionalism and medical ethics were emphasized through role modeling and religious values.

The developmental journey of professionalism continues towards defining concrete terms for professionalism. Before 1910 the apprenticeship model was dominantly practiced by medical schools. In this model professionalism is learned by students through role models of their supervisors. A significant development in medical education started in the early twentieth century with the Flexner report of 1910. The Flexner report criticized the apprenticeship model of medical education by being insufficient to graduate competent physicians. In contrast, Flexner proposed an increase in scientific knowledge and more practice of medicine.[21] Flexner's model was adopted widely in developed as well as developing countries. The model resulted in more factual medical knowledge acquisition and departmentalization of medical schools based on disciplines. Accordingly, the number of specialties that has to be taught to students increased exponentially. Teaching was consequently conducted in traditional classrooms, laboratories and academic hospitals. Some elements of professionalism are covered in this model of medical education. This approach is criticized because it puts little emphasis on the other important elements of professionalism such as altruism, self-motivation and social accountability. Moreover the comprehensive and holistic approach to patient care receives less attention.

Contemporary development of professionalism

In 1960s, societal values began to change in developed countries as a result of the human rights movement. Equal rights in all areas of human existence, including health, were highlighted.[22] Governments became more aware of the inequity of access to services to their population, and established social security and welfare departments with the aim of giving equal health services to all individuals regardless of their socio-economic, age or ethnic backgrounds.[22] In North America many challenges faced the health care system which was managed largely by independent Health Maintenance Organizations, HMOs, the provision of health care had increasingly become a business. As a result of this for-profit health care market, the very core of medicine was felt to be eroding. Evolving trends in medical care favored cost-effectiveness and efficacy and, as expected, had adversely affected certain aspects of the medical profession. As a response to these societal and health system changes, medical education started to change in parallel. Many medical schools, in particular in developed countries, concluded that the prevalent model of medical education was not optimal for producing graduates who are professional and able

to respond to the needs of patients and the population at large. The question of relevance of medical education to professionalism and societal needs was raised.

Consequently, medical education has experienced significant changes in late seventies, which resulted in a new model emphasizing relevance of curriculum to priority health problems and societal needs. In this model student-centered learning, problem-based learning, and community-orientation were emphasized. In this approach to medical education, professionalism elements and attributes were integrated with problems and blocks throughout the curriculum.[23] In the early nineties the outcome-based model as represented by competency-based learning emerged. The CanMEDs framework has been widely adopted by many medical schools worldwide. This framework of seven competencies includes professionalism as an essential domain with a list of enabling competencies. The framework guided curriculum design for undergraduate medical education and residency training. Other frameworks of competency based education consequently evolved such as ACGME (USA),[24] Tomorrow's Doctors (UK),[25] The Scottish Doctor (Scotland),[25] and SaudiMEDs (Saudi Arabia).[26] Professionalism is included in the four frameworks as an important element, comprehensively stressed in the curriculum, with accreditation standards, and in medical practice stressing teamwork building, leadership, communication and altruism. Those elements of professionalism were integrated in the medical schools and included in teaching and student assessment.[27] At the same time another significant development of professionalism started with the development of The Physician Charter on Professionalism through a collaboration of the ABIM Foundation, the ACP Foundation and the European Federation of Internal Medicine. The most commonly used framework for professionalism is the western framework which was first described by the American Association of Internal Medicine. Many authors questioned the generalizability of the model to fit different cultures and situations. The first question in this regard was raised by editor of the Physician Charter, "Does this document represent the traditions of medicine in cultures other than those in the west, where the authors of the charter have practiced medicine?"[34] Many researchers from other cultures continue in the same argument. For instance, the Taiwanese physician Ho asked the question "Does one size fits all?"[30] Her research led to the Taiwanese culture framework which described in Greek temple (Figure 1.1). Other cultures such as Japanese originated a distinctive framework which is based on the Bushido value, a deeply rooted believes in the Japanese culture that shapes their framework. Al Eraky on the other hand came with another unique model of the Arabian culture which he named the four-gates model (Figure 1.2).[34]

The conclusion of the, so far available, research is that the Western model of professionalism was not found to fit all cultures. Consequently, other non-Western frameworks started to appear in Japan, China, Taiwan and the Arab world,[29-32] and each of these national frameworks thus originated in its own context and culture.

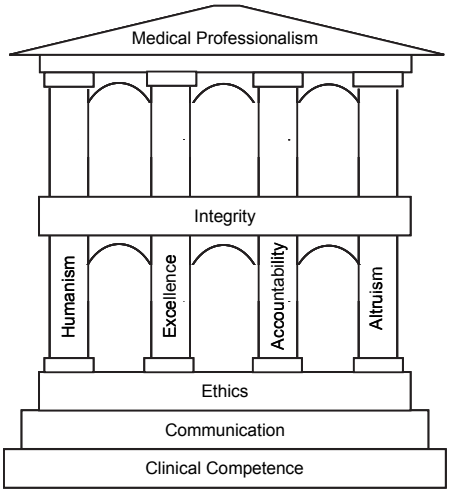

Figure 1.1 Greek Temple representation of the Taiwanese culture framework.[30]

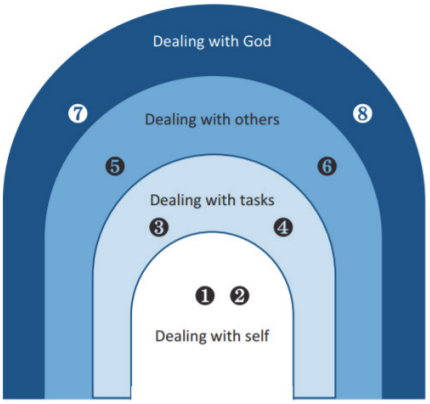

Figure 1.2 The Four Gates Framework of the Arab Culture.[32]

Teaching and assessment of professionalism will be the focus of the next section.

Teaching and assessing professionalism

The importance of teaching and assessing professionalism is illustrated by the fact that professionalism was considered as an important theme among graduate outcomes and

competencies. Additionally, it becomes an essential topic in most educational conferences and meetings in the last two decades. In the past, professionalism was assumed to consist of traits that learners will acquire irrespective of teaching and it will be manifested when they are practicing physicians. Recently, educators concluded that teaching and assessment of professionalism, to end up with an impact on physician's behavior, doesn't occur by chance alone. Indeed it should be well planned and integrated in all phases of the curriculum of all health professionals.[35]

Following the development of CanMEDs and other frameworks including professionalism, Sylvia and Richard Cruess, among others, advocated that the theme of professionalism be included in Undergraduate Medical Education.[36] For over a decade, a number of authors have outlined standards of professional behavior and emphasized the need for formal teaching of this subject matter in medical schools.[36,37] Under the theme of medical professionalism, the attributes and behaviors required of physicians-to-be formally integrated into the undergraduate curriculum of nearly every faculty of medicine across Canada.[38] This was not only the case in Canada yet is exemplary of a global development as illustrated by a huge number of publications and reviews in this endeavor. A few notable examples include the Dutch experience,[39] Mayo clinic experience,[40] and UK experience.[41] A framework to Principles for teaching professionalism were identified by Cruise 2006(36) and principles for teaching that were determined by Mueller 2009.[35]

In the section below I will describe how different health professions educational institutions responded to the teaching of professionalism based on two main frameworks independently proposed by Stern[42] and Brudy.[43] Accordingly, the different approaches to teach professionalism are discussed based some variables including onset, modalities and instructional methods, time allocated, responsibility, commitment and assessment methods

Instructional methods onset

Some medical educational institutions introduce professionalism at an early stage in the curriculum starting from the first year.[44] Others include it at a later stage of the curriculum, mainly in the clinical years.[45] And even others responded are using an integrated approach throughout the curricular years.

Instructional methods

Many instructional methods were used by different medical schools in both modalities including lectures, small group teaching, role plays, case studies, problem-based learning, and team-based learning. Other using only lectures for teaching professionalism.

Generally there are two main modalities of teaching professionalism in different health professional educational institutions; The first is stand-alone course mainly in the pre-

clinical years focusing on cognitive aspects of professionalism such as medical ethics and other attributes of professionalism.[46] This model focuses mainly on lecture-based didactic learning. The second modality is integration of professionalism throughout the curriculum emphasizing non-cognitive skills such as communication (language, empathy, integrity), collaboration (responsibility, respect, duty), and continuous improvement (recognition of limitations and motivation to improve).

Time allocated to teaching of professionalism

Some programs introduced few lectures within courses or don't include it all.[44] Others allocate significant amount of time within the curriculum amounting to more than twelve percent of the program such University of Sydney in Australia and King Saud bin Abdulaziz University for Health Sciences in Saudi Arabia.(Medical Education 2003;37:341–349)

Responsibility and organization

In some medical schools the responsibility lies within one department such as the department of community or behavioral sciences,[47] others opted to make it the responsibility of all departments in an integrated manner.

Commitment and motivation

Commitment and motivation determine the coverage and inclusion of professionalism with the curriculum. This variable also varies, some institution are highly committed as it is an obligation of accrediting and regulatory bodies such as Accreditation Council of Graduate medical education in the US.[48] Therefore, professionalism is included as core competency of all residency programs and many undergraduate medical schools in the |US. Others show commitments by including it in the mission statement of the institution.[49] Other medical schools show little commitment and motivation.

Assessment methods

As mentioned earlier, assessment of professionalism is still a challenge to medical educators and so far reliable and valid methods do not yet exist.[44] However there have been several attempts towards a valid and reliable assessment of professionalism.[50] Longitudinal assessment including formative and summative assessment is proposed utilizing multiple instruments. The most commonly used instruments are: Cognitive-based method such as, written patient scenarios, ethical dilemmas and multiple choice questions. Performance-based methods may include multi-source 360-degree reviews (e.g. by patients, nurses, peers, staff members and others), and objective structured clinical

examinations (OSCE). Other instruments for assessment comprise simulation, review of incident reports, and medical errors.[51]
More extensive reports on teaching and assessment of professionalism can be found elsewhere.[52]
In the previous sections, we have discussed professionalism from different perspective including historical background, definition, framework, teaching and assessment and the different factors influencing it. Clinical reasoning is interlinked to the concept of professionalism as both related to the quality of patient care. In the next section, we will discuss the second theme of this thesis which is clinical reasoning.

Clinical reasoning

Clinical reasoning is defined as diagnostic process including generation of hypotheses, hypotheses refinement through data gathering and interpretation, and diagnosis verification.[53] Having acknowledged the importance of professionalism as a generic competence in contemporary practice, it should however not be forgotten, that perhaps the most important, objectives of medical education, is surely helping students to become doctors who are able to accurately and efficiently solve diagnostic medical problems, as a medical competency. Solving diagnostic problems is a difficult task for several reasons. Many diseases share a limited number of complaints that in addition show considerable overlap. The acquisition of this skill is traditionally left to the clinical clerkships. On the ward students see their first real patients on whom they have to apply their knowledge of disease. Learning during the clerkships is however largely learning-by-doing, with restricted opportunities to critically review one's own performance.[54] What also doesn't help is that the number of, and variation in, patients available for practice is often limited. It will therefore come as no surprise that many medical schools have responded to this unsatisfactory state of affairs by beginning to teach clinical reasoning early in the curriculum, offering courses that provide students with ample opportunities to practice and take care of their supervision and feedback needs.

Teaching clinical reasoning

The instructional method almost universally used in courses on clinical reasoning can be described as the so called "serial-cue" approach. Basically, the serial-cue approach simulates a real clinical encounter, in which students "play the doctor" and are requested to gather the information necessary to arrive at a diagnosis. Students may be asked to extract information either directly from real[55,56] or simulated patients,[57] sometimes played

by peers[58,59] or from a case presenter.[60,61] The information gathering usually takes place sequentially and in an interactive form. Students' step-by-step progress, from history taking to requesting diagnostic tests, with findings being unfolded in response to their information requests. While doing so they are asked to explain why they have requested that particular clinical information, and how it would help narrow the differential diagnosis.[55] A teacher interacts with the students, either while they are gathering the clinical information,[56,61] or in subsequent feedback sessions.

Despite its universal use and its seemingly authentic character, there are a number of potential problems with this approach. The first is that experienced physicians, when confronted with a patient's complaint, activate diagnostic hypotheses based on illness scripts (rich mental representations in memory of typical patients with a particular disease). These diagnostic hypotheses guide the process of search for appropriate information.[62] However, students initially lack such illness scripts and therefore have limited means to search for information that is most relevant for testing their hypotheses and for appreciating its significance. The second problem is that educational research on the effectiveness of the serial-cue approach is largely lacking. We found only four studies in the literature that attempted to study its usefulness,[57,59,63,64] only two of which consisted of a randomized trial.[57,59] The results were hardly promising. As compared with controls who did not receive any additional training, students in the serial-cue condition did not produce better differential diagnoses on a subsequent test.

More recently, alternative approaches to the teaching of clinical reasoning have emerged, all using a "whole-case" approach. Under this approach students are confronted with clinical cases that already contain all the patient's essential features and are required to produce a (differential) diagnosis.[65-68] A number of these studies involved randomized trials, but only one study directly compared a whole-case approach with the serial-cue methodology.[67] In this study, students confronted with the whole case performed better than those confronted with the serial-cue version of the case. Shortcomings of this study however was, that it only employed two cases and that performance of the students were only measured on these two training cases. It is preferable to test students' performance in such experiments on new cases.

Most of the studies discussed here, both from the serial-cue and the whole-case variety, implicitly assume that students have all the knowledge necessary to deal with the clinical cases presented to them. However, this is unlikely true for beginning and even for more advanced students. One of the investigators involved in this study has proposed a theory on how students' knowledge of disease changes over time while progressing through the curriculum.[62,69] In the first years of medical training students predominantly wrestle to understand how underlying pathophysiological processes cause the signs and symptoms of particular diseases. Mainly through the interaction with patients, simulated or on paper, they begin to see how human biology in communication with environmental influences

causes certain patterns of signs and symptoms to arise.[70] To help students apply their understanding of pathophysiology to the diagnosis of patients, Chamberland and colleagues[71] have developed a procedure in which students are required to explain to themselves and others, thinking aloud, and for a number of cases, how the symptoms in a case are produced by the underlying processes. They were able to show that, as compared with students who only had to provide a differential diagnosis, students engaging in such self-explanation, demonstrated more accurate diagnostic performance on a set of similar but more complex cases one week later. See also Chi and Bassok.[72]

Once students have developed (rudimentary) illness scripts for various complaints and signs a new challenge arises: How to distinguish between different diseases that share similar patterns of signs and symptoms such as viral hepatitis and hemolytic anemia; and how to learn to recognize that wildly different signs and symptoms nevertheless can point at the same disease? Mamede and colleagues have introduced a "compare-and-contrast" procedure called deliberate reflection. They present clinical vignettes to students and ask them to come up with an initial diagnosis. Then they ask students to indicate which signs and symptoms support their initial diagnosis, and which signs and symptoms do not support their diagnosis. Finally, students are asked to indicate which symptoms should have been there, if their diagnosis were true. Subsequently, they are asked whether another possible diagnosis now has come to mind. If so, they are required to apply the deliberate-reflection procedure again. If no new ideas emerge anymore, a final diagnosis is asked for. The investigators were able to show that, as compared with students who only had to provide a differential diagnosis, the deliberate-reflection group performed better not only on similar new cases but also on cases that displayed different yet adjacent diseases. It seemed that the exercise induced students not only to consider directly relevant diseases as cause for the suffering of patients but also possible alternatives.[73,74]

From above review of both professionalism and clinical reasoning, some gaps in the literature can be identified that raise research questions for this thesis, these include and not limited to the following:

First, medical professionalism across non-western culture is not well studied; second, perception of professionalism by learners in non-Western culture; and third, many studies have compared academic performance between graduate entry and school entry programs to medical schools, but to the best of our knowledge, no study so far focused on professionalism. There are many studies in the literature on effective methods for teaching clinical reasoning. However, studies on the comparison between self-explanation approach with deliberate-reflection strategy and the serial-cue procedure are lacking. In addition, which method is suitable for novice and intermediate students not yet studied? Investigations of whether hypothetico-deduction leads to consideration of more alternative diagnoses while practicing with clinical cases is also not well studied in the literature.

Moreover whether its advantage over self-explanation will be replicated in other disease situation?

Objectives of studies in this thesis

This thesis has five objectives covering the two related themes, each objective will be highlighted in a separate study as follows:

Professionalism

Explore the perceptions of pediatric residents regarding medical professionalism within the two healthcare tertiary settings in Riyadh, Saudi Arabia. Pediatric residents from two healthcare institutions, Study One Chapter Two. To conduct a systematic review to identify non-Western framework of professionalism, Study Two, Chapter Three. To identify the performance of graduate entry program and school entry program in professional behavior, Study Three, Chapter Four.

Clinical reasoning

Compare self-explanation approach with deliberate-reflection strategy and the serial-cue procedure in teaching clinical reasoning to medical students and determine which approach is most suitable to teach clinical reasoning for novices as well as for intermediates and advances medical students, Study Four, Chapter Five.
Investigate whether hypothetico-deduction leads to consideration of more alternative diagnoses while practicing with clinical cases, and whether its advantage over self-explanation will be replicated when diseases slightly different from the ones previously studied are tested, Study Five, Chapter Six.

Outline of the thesis

This thesis is thus focusing on two related themes: professionalism and clinical reasoning. Study one, two and three are dealing with professionalism while study four and five are on clinical reasoning. The next section briefly outlines each study.

Studies on professionalism

Study one

Medical professionalism is context-specific, but most literature on professionalism stems from Western countries. The second study is about benchmarking of different frameworks on professionalism and interpreting the commonalities and discrepancies of understanding professionalism across different cultures. We need to study the cultural underpinning of medical professionalism to graduate future "global" practitioners who are culturally sensitive enough to recognize differences (and also similarities) of expectations of patients in various contexts. This study describes culture specific elements of three identified non-Western frameworks of professionalism as well as their commonalities and differences. A narrative overview is carried out of studies that address professionalism in non-Western cultures for the period 2002-2014.

Study two

The teaching of principles of medical professionalism and medical ethical issues are two essential components of graduate medical education curriculum associated with better quality clinical practice and health outcomes of healthcare consumers across all levels of healthcare delivery. The first study is a cross-sectional descriptive study that explores the perceptions of pediatric residents regarding medical professionalism within the two healthcare tertiary settings in Riyadh, Saudi Arabia Pediatric residents from two healthcare institutions are voluntarily invited to participate and ask to assess their attitudes towards medical professionalism by filling up a modified, self-administered questionnaire.

Study three

King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) is the first university in the Kingdom of Saudi Arabia offering both high school entry and graduate entry (GE) students into medical school. In this study we will compare the academic performance and professionalism lapses of high school entry and GE students who undertook the same curriculum and examinations in the College of Medicine, Riyadh, KSAU-HS. Examination scores of high school graduates and graduate entry students over a 4-year period (2010–2014) will be used as a measure of academic achievement. For assessment of professionalism lapses, we will compare the number of warning letters regarding unprofessional behaviors in both streams of students as an indirect measure of professional behavior. This is the first Saudi study to compare the performance of high school entry and GE students in a medical school.

Studies on clinical reasoning

Study four

Self-explanation while individually diagnosing clinical cases has proved to be an effective instructional approach for teaching clinical reasoning. The present study compared the effects on diagnostic performance of self-explanation in small groups with the more commonly used hypothetico-deductive approach.

In this study second-year students from a six-year medical school in Saudi Arabia will work in small groups on seven clinical vignettes (four criterion cases representing cardiovascular diseases and three 'fillers', i.e. cases of other unrelated diagnoses). The students will follow different approaches to work on each case depending on the experimental condition to which they have been randomly assigned. Under the self-explanation condition, students will provide a diagnosis and a suitable pathophysiological explanation for the clinical findings whereas in the hypothetico-deduction condition students will hypothesize about plausible diagnoses for signs and symptoms that are presented sequentially. One week later, all students will diagnose eight vignettes, four of which will represent cardiovascular diseases. A mean diagnostic accuracy score (range: 0–1) will be computed for the criterion cases. One-way ANOVA with experimental condition as between-subjects factor will be performed on the mean diagnostic accuracy scores.

Study five

Approaches for the teaching of clinical reasoning have been much discussed, but empirical research on their effectiveness is scarce. This study will investigate whether hypothetico-deduction leads to consideration of more alternative diagnoses while practicing with clinical cases, and whether its advantage over self-explanation will be replicated when diseases slightly different from the ones previously studied are tested.

In this study**,** one-hundred thirty-nine 2nd-year students from a six-year medical school in Saudi Arabia will participate in a two-phase experiment. In the learning phase, they will work in small groups on five clinical vignettes representing cardiovascular diseases. The participants will follow different approaches to work on each depending on the experimental condition to which they will be assigned. Students under the self-explanation condition will provide a diagnosis and a pathophysiological explanation for the clinical findings while under the hypothetico-deduction condition students will hypothesize about plausible diagnoses for clinical findings that are presented sequentially. One week later, all students will go over the diagnoses of eight cases in cardiovascular diseases with clinical presentation similar to the ones studied in the learning phase but different diagnoses. Univariate analyses of variance will be conducted with experimental condition as

independent variable and the mean number of diagnoses considered in the learning phase and mean diagnostic accuracy score (range 0-1) in the test as independent variables.

References

1. Hafferty F. Socialization, professionalism, and professional identity formation. In: R. Cruess, S. Cruess, & Y. Steinert (Eds.), Teaching Medical Professionalism: Supporting the Development of a Professional Identity Cambridge: Cambridge University Press. 2016:54-67.
2. Thistlewaite J SJ. Professionalism in Medicine. 2008; Ch.1, pp 3-4: Oxford, Radcliffe Publishing:; 2008.
3. Eva KW. What every teacher needs to know about clinical reasoning. Med Educ. 2005;39(1):98-106.
4. Braun LT, Zwaan L, Kiesewetter J, Fischer MR, Schmidmaier R. Diagnostic errors by medical students: results of a prospective qualitative study. BMC Med Educ. 2017;17(1):191.
5. Hodges BD, Ginsburg S, Cruess R, Cruess S, Delport R, Hafferty F, et al. Assessment of professionalism: recommendations from the Ottawa 2010 Conference. Med Teach. 2011;33(5):354-63.
6. Calman K. The profession of medicine. BMJ. 1994;309(6962):1140-3.
7. van Mook WN, van Luijk SJ, van der Vleuten CP. [Professional behaviour during medical training]. Ned Tijdschr Geneeskd. 2009;153:A542.
8. Cruess RL, Cruess SR, Boudreau JD, Snell L, Steinert Y. Reframing medical education to support professional identity formation. Acad Med. 2014;89(11):1446-51.
9. Swick HM. Toward a normative definition of medical professionalism. Acad Med. 2000;75(6):612-6.
10. In: Balogh EP, Miller BT, Ball JR, editors. Improving Diagnosis in Health Care. Washington (DC)2015.
11. https://en.wikipedia.org/wiki/Hippocratic_Oath.
12. Saliba G. A History of Arabic Astronomy: Planetary Theories During the Golden Age of Islam. New York University Press,. 1994(ISBN 0-8147-8023-7):245, 50, 56–57.
13. Papadakis MA, Hodgson CS, Teherani A, Kohatsu ND. Unprofessional behavior in medical school is associated with subsequent disciplinary action by a state medical board. Acad Med. 2004;79(3):244-9.
14. Bynum WF PR. Companion Encyclopedia of the History of Medicine. Routledge Companion Encyclopedias. 1997;2.
15. Avicenna. The Canon of Medicine (Original title: القانون في الطب) Medical Literature. 1025;Volume 1 to 5:(Wikipedia).
16. Majeed A. How Islam changed medicine. BMJ. 2005;331(7531):1486-7.
17. Arawi TA. The muslim physician and the ethics of medicine. J IMA. 2010;42(3):111-6.
18. Masic I. Thousand-year anniversary of the historical book: "Kitab al-Qanun fit-Tibb"- The Canon of Medicine, written by Abdullah ibn Sina. J Res Med Sci. 2012;17(11):993-1000.
19. Wynia MK. The short history and tenuous future of medical professionalism: the erosion of medicine's social contract. Perspect Biol Med. 2008;51(4):565-78.
20. Baker CJ. Professionalism. N Engl J Med. 2007;356(9):966; author reply
21. Cooke M, Irby DM, Sullivan W, Ludmerer KM. American medical education 100 years after the Flexner report. N Engl J Med. 2006;355(13):1339-44.
22. Fulton JF. History of medical education. Br Med J. 1953;2(4834):457-61.
23. Duffy TP. The Flexner Report--100 years later. Yale J Biol Med. 2011;84(3):269-76.
24. Srinivasan M, Li ST, Meyers FJ, Pratt DD, Collins JB, Braddock C, et al. "Teaching as a Competency": competencies for medical educators. Acad Med. 2011;86(10):1211-20.
25. Ellaway R, Evans P, McKillop J, Cameron H, Morrison J, McKenzie H, et al. Cross-referencing the Scottish Doctor and Tomorrow's Doctors learning outcome frameworks. Med Teach. 2007;29(7):630-5.
26. Zaini RG, Bin Abdulrahman KA, Al-Khotani AA, Al-Hayani AM, Al-Alwan IA, Jastaniah SD. Saudi Meds: a competence specification for Saudi medical graduates. Med Teach. 2011;33(7):582-4.
27. Chang BJ. Problem-based learning in medical school: A student's perspective. Ann Med Surg (Lond). 2016;12:88-9.
28. In: Smedley BD, Stith Butler A, Bristow LR, editors. In the Nation's Compelling Interest: Ensuring Diversity in the Health-Care Workforce. Washington (DC)2004.
29. Nishigori H, Harrison R, Busari J, Dornan T. Bushido and medical professionalism in Japan. Acad Med. 2014;89(4):560-3.
30. Ho MJ, Yu KH, Hirsh D, Huang TS, Yang PC. Does one size fit all? Building a framework for medical professionalism. Acad Med. 2011;86(11):1407-14.
31. Pan H, Norris JL, Liang YS, Li JN, Ho MJ. Building a professionalism framework for healthcare providers in China: a nominal group technique study. Med Teach. 2013;35(10):e1531-6.

32. Al-Eraky MM, Donkers J, Wajid G, van Merrienboer JJ. A Delphi study of medical professionalism in Arabian countries: the Four-Gates model. Med Teach. 2014;36 Suppl 1:S8-16.
33. Combes JR, Arespacochaga E. Physician competencies for a 21st century health care system. J Grad Med Educ. 2012;4(3):401-5.
34. Medicine AFABoI, Medicine A-AFACoP-ASoI, European Federation of Internal M. Medical professionalism in the new millennium: a physician charter. Ann Intern Med. 2002;136(3):243-6.
35. Mueller PS. Teaching and assessing professionalism in medical learners and practicing physicians. Rambam Maimonides Med J. 2015;6(2):e0011.
36. Cruess RL, Cruess SR. Teaching professionalism: general principles. Med Teach. 2006;28(3):205-8.
37. van Mook WN, de Grave WS, van Luijk SJ, O'Sullivan H, Wass V, Schuwirth LW, et al. Training and learning professionalism in the medical school curriculum: current considerations. Eur J Intern Med. 2009;20(4):e96-e100.
38. Byszewski A, Gill JS, Lochnan H. Socialization to professionalism in medical schools: a Canadian experience. BMC Med Educ. 2015;15:204.
39. Barnhoorn PC vM, Walther N. K. A. . Professionalism or professional behaviour: no reason to choose between the two. Medical Education. 2015;49:740-.
40. Brennan MD. Professionalism and academic medicine: the Mayo Clinic program in professionalism. Ir J Med Sci. 2008;177(1):23-7.
41. Goldie J. Integrating professionalism teaching into undergraduate medical education in the UK setting. Med Teach. 2008;30(5):513-27.
42. Thomas Stern D. Measuring medical professionalism2006.
43. Brody H, Doukas D. Professionalism: a framework to guide medical education. Med Educ. 2014;48(10):980-7.
44. Hendelman W, Byszewski A. Formation of medical student professional identity: categorizing lapses of professionalism, and the learning environment. BMC Med Educ. 2014;14:139.
45. Geoff Whitty (2000) Teacher professionalism in new times JoI-SE, 26:2, 281-295, DOI: 10.1080/13674580000200121.
46. Birden H, Glass N, Wilson I, Harrison M, Usherwood T, Nass D. Teaching professionalism in medical education: a Best Evidence Medical Education (BEME) systematic review. BEME Guide No. 25. Med Teach. 2013;35(7):e1252-66.
47. Altirkawi K. Teaching professionalism in medicine: what, why and how? Sudan J Paediatr. 2014;14(1):31-8.
48. Stockley AJ, Forbes K. Medical professionalism in the formal curriculum: 5th year medical students' experiences. BMC Med Educ. 2014;14:259.
49. Sivalingam N. Teaching and learning of professionalism in medical schools. Ann Acad Med Singapore. 2004;33(6):706-10.
50. Karukivi M, Kortekangas-Savolainen O, Saxen U, Haapasalo-Pesu KM. Professionalism Mini-Evaluation Exercise in Finland: A preliminary investigation introducing the Finnish version of the P-MEX instrument. J Adv Med Educ Prof. 2015;3(4):154-8.
51. Mueller PS. Incorporating professionalism into medical education: the Mayo Clinic experience. Keio J Med. 2009;58(3):133-43.
52. van Mook WN, Gorter SL, de Grave WS, van Luijk SJ, O'Sullivan H, Wass V, et al. Professionalism beyond medical school: an educational continuum? Eur J Intern Med. 2009;20(8):e148-52.
53. Cruess RL, Cruess SR, Boudreau JD, Snell L, Steinert Y. A schematic representation of the professional identity formation and socialization of medical students and residents: a guide for medical educators. Acad Med. 2015;90(6):718-25.
54. van Loon KA, Driessen EW, Teunissen PW, Scheele F. Experiences with EPAs, potential benefits and pitfalls. Med Teach. 2014;36(8):698-702.
55. Goss JR. Teaching clinical reasoning to second-year medical students. Acad Med. 1996;71(4):349-52; discussion 8.
56. Linn A, Khaw C, Kildea H, Tonkin A. Clinical reasoning - a guide to improving teaching and practice. Aust Fam Physician. 2012;41(1-2):18-20.
57. Littlefield JH, Hahn HB, Meyer AS. Evaluation of a Role-Play Learning Exercise in an Ambulatory Clinic Setting. Adv Health Sci Educ Theory Pract. 1999;4(2):167-73.
58. Windish DM. Teaching medical students clinical reasoning skills. Acad Med. 2000;75(1):90.
59. Windish DM, Price EG, Clever SL, Magaziner JL, Thomas PA. Teaching medical students the important connection between communication and clinical reasoning. J Gen Intern Med. 2005;20(12):1108-13.

60. Dequeker J, Jaspaert R. Teaching problem-solving and clinical reasoning: 20 years experience with video-supported small-group learning. Med Educ. 1998;32(4):384-9.
61. Kassirer JP. Teaching clinical reasoning: case-based and coached. Acad Med. 2010;85(7):1118-24.
62. Schmidt HG, Rikers RM. How expertise develops in medicine: knowledge encapsulation and illness script formation. Med Educ. 2007;41(12):1133-9.
63. Bacchus CM, Quinton C, O'Rourke K, Detsky AS. A randomized crossover trial of Quick Medical Reference (QMR) as a teaching tool for medical interns. J Gen Intern Med. 1994;9(11):616-21.
64. Chamberland M. [Clinical reasoning learning (CRL) sessions. An example of a contextualized teaching activity adapted to clinical stages in medicine]. Ann Med Interne (Paris). 1998;149(8):479-84.
65. Bye AM, Connolly AM, Farrar M, Lawson JA, Lonergan A. Teaching paediatric epilepsy to medical students: A randomised crossover trial. J Paediatr Child Health. 2009;45(12):727-30.
66. Montaldo LG, Herskovic LP. [Teaching of clinical reasoning to medical students using prototypical clinical cases]. Rev Med Chil. 2013;141(7):823-30.
67. Nendaz MR, Raetzo MA, Junod AF, Vu NV. Teaching Diagnostic Skills: Clinical Vignettes or Chief Complaints? Adv Health Sci Educ Theory Pract. 2000;5(1):3-10.
68. Sacher AG, Detsky AS. Taking the stress out of morning report: an analytic approach to the differential diagnosis. J Gen Intern Med. 2009;24(6):747-51.
69. Schmidt HG, Norman GR, Boshuizen HP. A cognitive perspective on medical expertise: theory and implication. Acad Med. 1990;65(10):611-21.
70. Woods NN. Science is fundamental: the role of biomedical knowledge in clinical reasoning. Med Educ. 2007;41(12):1173-7.
71. Chamberland M, St-Onge C, Setrakian J, Lanthier L, Bergeron L, Bourget A, et al. The influence of medical students' self-explanations on diagnostic performance. Med Educ. 2011;45(7):688-95.
72. Chi MTH BM, Lewis MW, Reimann P, Glaser R. . Self-explanations - How students study and use examples in learning to solve problems. Cognitive Science. 1989;13(2):145-82.
73. Mamede S, van Gog T, Moura AS, de Faria RM, Peixoto JM, Rikers RM, et al. Reflection as a strategy to foster medical students' acquisition of diagnostic competence. Med Educ. 2012;46(5):464-72.
74. Mamede S, van Gog T, Sampaio AM, de Faria RM, Maria JP, Schmidt HG. 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. Acad Med. 2014;89(1):121-7.

Chapter 2

Pediatric Resident's Perceptions of Professionalism in Riyadh, Saudi Arabia

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Abstract

Background: The teaching of principles of medical professionalism and medical ethical issues are two essential components of graduate medical education curriculum coupled with better quality clinical practice and health outcomes of healthcare consumers. This cross-sectional descriptive study aims to explore the perception of pediatric resident regarding medical professionalism within two healthcare tertiary settings in Riyadh, Saudi Arabia.

Methods: Pediatric residents (n=67) from two healthcare institutions were voluntarily invited to participate and were asked to assess their attitudes towards medical professionalism by completing a self-administered questionnaire.

Results: 43 pediatric residents participated with a response rate of 64%. 55% were females and 55% of them were in year 1 or 2 of their residency program. Overall, the majority of participants rated themselves very good to excellent on all elements of professionalism. No attitudinal differences were found in all items of professionalism between age groups ($p<0.05$). A significant difference ($p=0.03$) was found between males and females in overall level of professionalism.

Conclusion: in light of this study most pediatric residents favorably perceived medical professionalism concept and underlying principles. A further study with a larger sample size is warranted in the future.

Introduction

There has been a major focus on professionalism in the recent years, the concept of medical education is about the acquisition of new knowledge and skills.[1,2] The Canadian CanMED 2000 model describes seven general areas of medical specialist competence and one of them to be recognized is professionalism.[3] There are two prevailing view of professionalism, personal or behavioral characteristic, which fall short of the vision that aims at medical practice. Professionalism is reflective on the quality of medical treatment and the training programs and assessment must focus in the accountability for treatment.[4] American Board of Internal Medicine (ABIM) and several other medical institutions have renewed their interest and focus on enhancing professionalism both in clinical practice and teaching medicine, together with twelve learning objectives for medical student education around the world.[5,6] Guidelines for undergraduate education were developed and accordingly students must develop and demonstrate appropriate attitudes towards medical professionalism during their training career. Healthcare providers, based on three fundamental principles of professionalism including primacy of patient welfare, patient autonomy and social justice, should commit to professional competency, honesty with patients, patient confidentiality, as well as maintaining appropriate relations with patient, improving quality of care, improving access to care, a just distribution of finite resources, scientific knowledge, maintaining trust by managing conflicts of interest and professional responsibilities.[5,6] A qualitative study aimed at conceptualizing professionalism[7] presented three themes of professionalism that included interpersonal professionalism, public professionalism and interpersonal public professionalism and interpersonal professionalism.

In the early 1990s, the Accreditation Council for Graduate Medical Education (ACGME) considered professionalism to be one of the six core competencies (other were patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication and systems-based-practice) skills and recommended that related programs on professionalism needed to be taught rigorously to students in training and evaluation should follow, during examination.[8] Notably, ACGME accreditation now requires program directors to document that their residents have met pre-determined performance standards in six general competences including professionalism. Therefore, teaching professionalism and evaluating the degree to which a resident meets acceptable and established criteria for professionalism is essential.

The American Board of Internal Medicine (ABIM) initiated an evaluation of professionalism on the recertification process of practicing physicians using evaluation and assessing methods from a toolbox developed by ACGME and American Board of Medical Specialties.[9] The American Board of Pediatrics set out important principles/components included in

specific guidelines for teaching and evaluation of professionalism as part of the core curriculum for residency training in pediatrics. These principles/components of professionalism are: honesty and integrity, reliability and responsibility, respect for others, compassion/empathy, self-improvement, self-awareness/knowledge of limits, communication and collaboration, altruism and advocacy.[10] Professionalism can be defined as the means by which individual doctors fulfill the medical profession's contract with society. The elements of professionalism include altruism, respect, honesty, integrity, dutifulness, honor, excellence and accountability that are reported to impact health outcomes.[11,12] Descriptions of these terms are listed in (Table 2.1).

Table 2.1 Elements of professionalism with sample items statement.

Element	Sample Item Statement
Accountability	Works collaboratively and respectfully within a team to the benefit of improved patient care or to the contribution of research
Enrichment	Shows a willingness to initiate and offer assistance toward a colleague's professional and personal development
Equity	Adopt uniform and equitable standards for patient care
Honor & Integrity	Uphold scientific standards and bases decisions in scientific evidence and experience
Altruism	Show compassion and empathy
Duty	Participates in corrective action process toward those who fail to meet professional standards of conduct
Respect	Avoids offensive speech that offers unkind comments and unfair criticisms to others

Favorable attitudes towards professionalism involve a healthy discussion with participants about its advantages, with regards to quality care, proper communication, mutual enhanced satisfaction of health providers and consumers and outcome together with unfavorable attitudes and its devastating disadvantages. Other perspectives of professionalism including importance of continuity of healthcare with regard to chronic conditions, professional relationships, excellence, honesty and improving knowledge and its regular update, and advocacy of professionalism need to be addressed during training of medical graduates. There is a broad scope of approaches to teaching professionalism in graduate medical education, the hospital to home program, role play with simulated patients, challenging case conferences, leadership training, cultural sensitivity presentations and web-based curriculum.[13-18] Similarly, there is a board scope of specific approaches to assessing professionalism in graduate medical education as well, including Hickson codes, Holleran Char Abstraction Protocol. Transitional Visit skill assessment, Stern Value Code, Barry Challenges to Professionalism Questionnaire, Musick 3600 Evaluation and Wake Forest Physician Trust Scale.[19-25] These methods of teaching professionalism during graduate training, and assessment methods, focus on several specific teaching techniques, each with its own assessment tools.

There is converging evidence that when doctors have appropriate attitudes towards and excellence in professionalism reflected in a physician's warm, friendly welcome and

reassuring manner, it will affect their relationship with health consumers/patients whose quality of care, trust, persistence/compliance and satisfaction, and ultimately, health outcomes will improve tremendously.[11,12,24,26-28] On the other hand, patients could bring legal action against physicians who behave unprofessionally.[19] Doctors should improve their professional attitudes and learn ethical standards of medical professionalism including patient confidentiality, appropriate relations with patients, maintaining trust by managing conflicts of interest, improve quality of care, improving access to care, commitment to scientific knowledge, meeting the relationship-centered expectations, and just distribution of finite resources during their formative years as students and residents. Medical educators have a critical role to play in ensuring that future doctors are prepared to fulfill their professional obligation with trustworthiness. Despite the essential nature of professionalism in health care, there is little programmatic or curricular emphasis on building professional skills in either clinical practice or training across specialties in the Eastern World. Instead, a preponderance of time is spent on facts and procedures, with minimal attention to feelings, relationships, and continuity of good quality of care.

Assessment of healthcare providers' attitude towards professionalism is a research avenue that needs to be explored because favorable attitude and good excellent professional practice are reciprocally intertwined and result in good health outcomes.

Aim of the study

The aim of the study is to explore pediatric resident's perception of professionalism in dealing with patients and their families.

Objectives of the study

The objectives of the study were:

1. To describe the perceived meaning of medical professionalism among pediatric residents.
2. To evaluate pediatric residents rating of their own level of professionalism.
3. To compare the views of the pediatric resident towards professionalism with its concepts found within the medical literature.

Methods

Study design

A cross-sectional survey design using quantitative research methods was used in this research. Data was collected using a self-administered questionnaire.[29] The pediatric residents at King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) at the King Abdulaziz Medical City, Riyadh (KAMC-R) and King Fahad Medical City (KFMC) participated in this study.

Sampling size calculation

Sample size was estimated using G*Power version 3.01 for sample size calculation based on two tailed test. The assumption that relationship between professionalism and seniority is higher, therefore, a high effect size (0.50) for t test was considered. A total sample size of 42 was obtained from the G*Power software for an alpha of 0.05 and an actual power of 0.95. Sixty seven pediatric residents were invited, and 43 agreed to participate, a response rate of 64%.

Seating and participant

The study was conducted at the KSAU-HS/KAMC-R, KFMC. Both health institutions are considered as a tertiary centers dealing with a wide variety of patient population. Al pediatric residents are registered at the Saudi Council for Health Specialties (SCHS). One part of their assessment form is about professionalism.[30] Sixty seven pediatric residents under training at KSAU-HS/KAMC-R (n=35) and KFMC (n=32) were invited to participate in the study. The residents were at various level of training between year one and year four. Those who gave a written informed consent, participated in the study (n=43).

Data collection

The questionnaire was distributed among residents during their half academic day. They were asked to complete the questionnaire, which was then collected by the residency program's secretary. The questionnaires were crosschecked by the collecting person and in case of incomplete questionnaires, the questionnaires were returned to the respective participant for completion.

Survey questionnaires

The survey questionnaire was a modified version of the American Board of Internal Medicine (ABIM) Patient Assessment Survey which is part of the Patients and Physicians

Peer Assessment Module for maintenance of certification. The questionnaire was modified and used on physicians by researchers,[29] by using the third-person tense (e.g. "greeting them warmly"), instead of the second-person (e.g. "greeting you warmly") while otherwise preserving the exact same wording. The survey questionnaire included 11 questions about various aspects on communication skills and professionalism of the physicians.[29] Participants were required to rate each of these aspects on five-point Likert scale ranging from 1 (poor) to 5 (excellent). The questionnaire was further modified to evaluate the pediatric residents' professionalism towards the patients' family, by adding the family (e.g. "greeting them and their family warmly"). It also included additional questions related to resident demographic characteristics (age, sex) and educational characteristics (year of residency). The reliability (Cronbach's alpha) of the questionnaire was 0.89 that reflected a very good internal consistency.

Data management and analysis plan

All data was managed and computed using the Statistical Package for the Social Sciences/Personal Computer (SPSS/PC) version 16. Preliminary data analysis included descriptive statistics to describe the study sample demographic and educational characteristics, study variables and participants ratings of the questionnaire items. The total score was computed by tabulating the sum of all 11 items to provide a continuous outcome measure of professionalism. T test was applied to compare differences in professionalism between males and females and junior and senior residents.

Ethical considerations

A research proposal was submitted at the Institutional Review Board at the KSAU-HS/KAMC-R and KFMC for obtaining ethical approval to conduct this research. As this research did not entail any risk to the participants, we received approval from IRB. All participants were briefed about the objectives of the study and asked to participate. All gathered data and information was kept strictly confidential and was not allowed to be accessed by any other party without permission of the principle investigator.

Results

Out of 67 pediatric residents, 43 participated in the survey and completed the questionnaire (64.2% response rate). Table 2.2 demonstrates the participants' demographic and educational characteristics. Out of 43 participants, 24 were females (55.8%) and 19 were males (44.2%). The majority of respondents were in year 1 and 2 of the residency program.

Table 2.2 Socio-demographic Characteristics (n=43).

Sociodemographic variables	**Frequency (N=43)**	**%**
Sex		
Female	24	55.8
Male	19	44.2
Year of Residency		
Residency-year 1	16	37.2
Residency-year 2	12	27.9
Residency-year 3	7	16.3
Residency-year 4	8	18.6
Medical Degree		
King Saud University	12	27.9
King Abdulaziz University	6	14
King Faisal University	8	18.6
King Saud bin Abdulaziz University for Health Sciences	2	4.7
Other Universities	15	34.9

Table 2.3 demonstrates the frequencies of the residents rating of themselves in all items. Over all, most rated themselves very good to excellent on all elements of professionalism. When age was compared, no difference were found in all items related to professionalism between age groups ($p<0.05$). On comparison between graduates of Saudi Arabian medical schools and graduates of medical schools outside Saudi Arabia no significant statistical differences between groups ($p<0.05$) was noted. This is likely related to the small numbers of the participants in each group. However a significant different ($p=0.03$) was found between males and females in overall level of professionalism. Females rated themselves as more professional than males (Table 2.4).

Table 2.3 Frequencies of the residents rating themselves in all items.

Item	Gender	Frequencies					Total
		Poor	Fair	Good	Very Good	Excellent	
Telling them and/or their family everything; being truthful, upfront and frank; not keeping things from them that they should know	Females	0	1	6	14	3	24
	Males	0	1	7	5	6	19
Greeting them and/or their family warmly, calling them by the name they prefer; being friendly, never crabby or rude	Females	0	1	5	11	7	24
	Males	0	1	2	11	5	19
Treating them and/or family like they're on the same level; never "talking down" to them or treating them like a child	Females	0	0	4	14	6	24
	Males	0	2	2	6	9	19
Letting them tell their story, listening carefully, asking thoughtful questions, not interrupting them while they're talking	Females	0	0	8	11	5	24
	Males	0	0	9	4	6	19
Showing interest in them as a person, not acting bored or ignoring what they have to say	Females	0	1	5	10	6	24
	Males	0	1	3	11	4	19
Warning them and/or their family during the physical exam about what you are going to do and why, telling them what to find?	Females	0	1	6	10	7	24
	Males	0	1	3	11	6	19
Discussing options with them and/or their family, asking their opinion: offering choices and letting them help decide what to do; asking what they think before telling them what to do	Females	0	5	5	9	5	24
	Males	0	4	5	5	4	19
Encouraging them and/or their family to ask questions; answering them clearly, never avoiding their questions or lecturing them	Females	0	1	9	10	4	24
	Males	0	4	13	18	8	19
Explaining what they need to know about their child's problem, how and why they occurred and what to expect next	Females	0	1	5	17	1	24
	Males	0	2	5	9	3	19
Using words they can understand when explaining their problems and treatment, explaining any technical medical terms in plain language	Females	0	1	5	12	6	24
	Males	0	3	6	5	5	19
How would you rate your level of professionalism	Females	0	1	7	13	3	24
	Males	0	2	6	8	3	19

Table 2.4 Independent sample test.

	f.	Sign.	T
Telling them and/or their family everything etc.	3.603	.065	.197
Greeting them and/or their family warmly etc.	.222	.640	.211
Treating them and/or family like they're on the same level	4.463	.041*	.292
Letting them tell their story; listening carefully etc.	2.901	.096	.132
Showing interest I them as a person, etc.	.022	.884	.282
Warning them and/or their family during the physical exam, etc.	3.132	.084	.842
Discussing options with them and/or their family etc.	.457	.503	.620
Encouraging them and/or their family to ask questions	.991	.325	.087
Explaining what they need to know about their children/s	3.636	.064	.289
Using words they can understand, etc.	4.514	.040*	1.145
How would you rate your level of professionalism, etc.	1.328	.256	.476
Total of 11 items in percentages	4.895	.033*	.387

* significant.

Discussion

This study describes socio-demographic variables and perceptions of pediatric residents with regards to medical professionalism in two healthcare settings. The study had more females than males participate and it was found that the majority of participants were in the initial years of their training in pediatrics. Notably, most of them rated themselves as good to excellent almost on all items of medical professionalism. However, their significant perceptions were related to treating patients and /or families like they are not on the same level by using non-technical language/words so that their patients and the patient's family could understand and therefore, discuss any medical element at hand.

Most importantly, their overall self-assessment score on medical professionalism items was significantly higher, reflecting that they perceived the meanings of medical professionalism significantly well. The possible implications of the revealed favorable attitudes towards medical professionalism could be many as revealed in the literature on medical professionalism and related medical ethical issues: enhanced patients and their care givers satisfaction and so of health providers' satisfaction, good health outcomes, good continuity of and access to healthcare facilities, considerably reduced lawsuits against healthcare providers, healthy and trustful professional relationship between physicians and patients, equal distribution of health resources and good adherence and persistence with prescribed therapeutic interventions.[11,12,19,24,26,28] Whether or not revealed favorable attitudes tend to persist or erode over long-term period has not been researched much but continuing training programs on medical professionalism directed at physicians and good professional clinical practice help consolidate further their favorable attitudes towards medical professionalism.

According to our study, female pediatric residents rated themselves higher in terms of total score related to medical professionalism (p=<0.03). In another study,[29] males rated themselves higher than females in items related to explaining things to patients i.e., communication skills (p=<0.032) but in our study only borderline differences were found related to the same items (p=0.064). Compared to other studies, there were no differences between males and females in their perception of items related to professional behavior.[31] These conflicting results could be attributed to study design and methods, sample size, or assessment tools of medical professionalism. The tool used in our study could be utilized to raise the awareness of the residents towards professionalism, with special reference to doctor-patient communication, as well to expose them to a tool which has been used to survey patients perceptions about their doctor's professional behavior.

Notably, unfavorable attitudes in general can be modified. It is known that with targeted, defined interventions it is possible to change specific professional attitudes and beliefs,[32] reasoning[33,34] and behaviors.[21,35] Furthermore, the educational, ethical, cultural and working environment supplemented by observations of role models tend to change the attitude and ethical behavior of students.[22,36-39]

Teachers, while teaching professionalism to graduate medical students, should include specific behaviors', and categorize levels of professionalism in terms of ideal (consistently go beyond call of duty), expected (complete care and disposition of patients before signing them out), unacceptable (make passes at students and patients), egregious (falsify records) and also review professionalism scenarios.[23,40,41]

Our study has a few caveats including a low number of residents. However the tool appears to be internally consistent for resident's self-assessment of professionalism which can be reliably utilized. There is another expanded reliable and valid 36-item scale for assessing attitudes of medical students, residents, and faculty towards professionalism[42] that was developed after taking into account all elements of professionalism as suggested by the American Board of Internal Medicine (ABIM) and use of this scale might have produced detailed results.

In summary, female pediatric residents rated themselves significantly higher on medical professionalism and all participants rated themselves high with regard to total score of professionalism, as well as demonstrating a very good to excellent perception of all items of professionalism. Further studies on medical professionalism using a larger number of graduate medical students across all specialties are warranted.

References

1. Arnold L. Assessing professional behavior: yesterday, today and tomorrow. Acad. Med. 2002;77:502-15
2. Steiner Y, Curess S, Cruess R, Snell L. Faculty development for teaching and evaluating professionalism from program design to curriculum change. Med. Educ. 2005:39(2):127-36.
3. WebsuteL neds,qyeebsy,ca.medicine/oggyn/pdf/CanMEDS2000.pdf (accessed on 15 January 2012)
4. Verkerk MA, de Bree MJ, Mourits SME, Reflective professionalism: interpreting CanMEDS' "professionalism". J. Med. Ethics 2007;33:663-666.
5. Brennan T, Blank L, Cohen J et al. Project of ABIM Foundation, ACP-ASIM Foundation and European Federation of Internal Medicine. Medical professionalism in the new millennium: a physician charter. Ann.Intern.Med. 2002;136-243-6
6. The Medical Schools Objectives Project Learning objectives for medical student education guidelines for medical schools. Report 1 of the Medical Schools Objectives project. Acad. Med. 1999;74:13-8
7. Van De Camp K, Vernooij-Dassen MJFJ, Grol RPTM, Botemma BJAM. How to conceptualize professionalism: a qualitative study. Medical Teacher 2004;26:696-702
8. Accreditation Council for Graduate Medical
9. Toolgox for the evaluation of competence (http://www.acgme.org/outcomes/assess/toolbox.asp).
10. American Board of Pediatrics. Appendix F: professionalism. In: Program Director's Guide to the ABP: Resident Evaluation, Tracking & Certification. Chapel Hill, NC: American Board of Pediatrics; 2003.
11. Steward M, Brown JB, Donner A, McWhinney IR, Oates J, Weston WW, Jordan j. The impact of patient-centered care on outcomes. J. Fam Pract 2000; 49:796-804.
12. Di Basi Z, Harkness E, Ernst E, Georgiou A, Kleinnen J. Influence of context effects on health outcomes: a systematic review. Lancet 2001; 357:757-62.
13. Matter CA, Speice JA, McCann R, Mendelson DA, McCormick K, Friedman S, et al. Hospital to home: Improving internal medicine residents' understanding of the needs of older persons after a hospital stay. Acad Med 2003; 78:793-797.
14. Cullhane-Pera KA, Reif C, Egli E, Baker NJ, Kasskert R. A curriculum for multicultural education in family medicine. Fam Med 1997; 29: 719-723.
15. Markakis KM, Beckman HB, Suchman AL, Frankel RM. The path to professionalism: cultivating humanistic values and attitudes in residency training. Acad Med 2000; 75: 141-150.
16. Kuczewski KG, Bading E, Langbein M, et al. Fostering professionalism: the Loyola model. Camb Q Healthc Ethies 2003; 12: 161-166.
17. Rosenfeld JC, Sefcik S. Utilizing community leaders to teach professionalism. Curr Surgery 2003; 60: 222-224.
18. Hugget JM, Snyder KE, Gay SB, Jackson J, Mackey A. A web-based system of instruction and self-evaluation in patient confidentiality and informed consent. Poster presented at the 2003 ACGME Annual Educational meeting, Chicago March 5-6, 2003.
19. Hickson GB, Federspiel CF, Pichert JW, et al. Patient complaints and malpractice risk. JAMA 2002; 287: 2951-2957.
20. Holleran S, Starkey G, Burke P, Steele G, Folse R. An educational intervention in the surgical intensive care unit to improve ethical decisions. Surgery 1995; 118(2): 294-298
21. Beckman H, Frankel R, Kihm J, Julesza G, Geheb M. Measurement and improvement of humanistic skills in first-year trainees. J. Gen Intern Med 1990; 5: 42-45.
22. Stem DT. Values on call: a method for assessing the teaching of professionalism. Acad Med. 1996; 71(10 seuppl): S37-39
23. Barry D, Cyran E, Anderson RJ. Common issues in medical professionalism: room to grown. Am J Med. 2000; 108: 136-142.
24. Hall MA, Zheng B, Dugan E, Camacho F, Kidd KE, Mishra A, et al. Measuring patients; trust in their primary care providers. Med Care Res Review 2002; 59: 293-318.
25. Musick DW, McDowell SM, Clark N, et al. Pilot study of a 360-degree assessment for physical medicine & rehabilitation residency programs. Am J Phys Med Rehabil 2003; 82: 394-402.
26. Muson MA. Professionalism in medicine: the department Chair's perspective on medical students and residents. Am J Med 1997; 103:253-255.
27. Hauck FR, Zyzanski SJ, Alemagno SA, Medalie JH. Patient perceptions of humanism in physicians: effects on positive health behaviors. Fam Med 1990; 22: 447-452.

28. Baldwin DC, Bunch WH. Moral reasoning, professionalism, and the teaching of ethics to orthopedic surgeons. Clin Orthop 2000; 378: 97-103.
29. Symons AB, Swanson A, McGuigan D, Orange S, Akl EA. A tool for self-assessment of communication skills and professionalism in resident. BMC Education 2009, 9:1-7.
30. Saudi Council for Health Specialties: http:www.scths.org.sa: Accessed between Saturday and Wednesday.
31. Nath C, Schmidt R, Gunel E. Perceptions of professionalism vary most with educational rank and age. J. Dent Educ 2006; 70(8): 825-834
32. Hayes RP, Stoudemire A, Kinlaw K, Dell M, Loomis A. Changing attitudes about end-of-life decision making of medical students third-year clinical clerkships. Psychosomatics 1999; 40:205-209.
33. Godkin M. Savageau J. The effect of a global multiculturalism track on cultural competence of preclinical medical students. Fam. Med. 2001;33(3):178-186.
34. Self DJ, Olivarez M. Retention of moral reasoning skills over the four years of medical education. Tech. Learn. Med. 1996;8:195-199
35. Phelan S, Obenshain S, Galey WR, Evaluation of non-cognitive professional traits of medical students. Acad. Med. 1993;68:779-803
36. Feudtner C, Christakis D, Christakis N. Do clinical clerks suffer ethical erosion? Students' perceptions of their ethical environment and personal development. Acad.Med. 1994;69(8):670-679
37. Brownell AKW, Cote L. Senior residents' views on the meaning of professionalism and how they learn about it. Acad. Med. 2001;76:734-838
38. Freeman VG, Rathore SS, Weinfurt KP, Schulman KA, Sulmasy DP. Lyfing for patients, physician deception of third-party payers. Arch. Intern. Med. 1999;159:2263-2270
39. Hoffmaster CB, Stewart MA, Christie RJ. Ethical decision making by family doctors in Canada, Britain and the United States. Soc. Sci. Med. 1991;33:647-653
40. Ginsberg S, Regehr G, Hatala R, McNaughton N, Frohna A, Hodges B, et al. Context, conflict and resolution: a new conceptual framework for evaluating professionalism. Acad. Med 2000;75(10 suppl.): S6-11
41. Larking GL. Mapping, modeling, and mentoring, charting a course for professionalism in graduate medical education. Camb. Q Health c. Ethics. 2003;12:167-177
42. Blackkall GF, Melnick SA, Shoop GH, George J, Lerner SM, Wilson PK, Pees RC, Kreher M. Professionalism in medical education: The development and validation of a survey instrument to assess attitudes.

Chapter 3

Professionalism Frameworks across Non-Western Cultures: A narrative overview

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Abstract

Background: Medical professionalism is context-specific, but most literature on professionalism stems from Western countries. This study is about benchmarking of different frameworks on professionalism and interpreting the commonalities and discrepancies of understanding professionalism across different cultures. We need to study the cultural underpinning of medical professionalism to graduate future 'global' practitioners who are culturally-sensitive enough to recognize differences (and also similarities) of expectations of patients in various contexts.

Aim: This study aims at describing culture specific elements of three identified non-Western frameworks of professionalism, as well as their commonalities and differences.

Method: A narrative overview was carried out of studies that address professionalism in non-Western cultures in the period 2002 - 2014.

Results: Out of 143 articles on medical professionalism, only four studies provided three structured professionalism frameworks in non-Western contexts. Medical professionalism attributes in non-Western cultures were influenced by cultural values. Out of the 24 identified attributes of professionalism, three attributes were shared by the three cultures. Twelve attributes were shared by at least two cultures and the rest of the attributes were unique to each culture.

Conclusion: The three frameworks provided culture specific elements in a *unique* conceptual framework of medical professionalism according to the region they originated from. There is no single framework on professionalism that can be globally acknowledged. A culture-oriented concept of professionalism is necessary to understand what the profession is dedicated to and to incorporate the concept into the medical students' and physicians' professional identity formation.

Introduction

Over the past twenty five years, substantial literature has been published on definitions and consensus on medical professionalism,[1] Cruess, Cruess.[2] However, studies done by professional medical organizations in Western culture thus defined it as a fulfillment of the medical profession's contract with society Pellegrino and Relman,[3] Sohl and Bassford.[4]. In the early 1980's, the American Board of Internal Medicine (ABIM) started its project on Humanism in which the following elements of professionalism were determined: accountability, altruism, excellence, duty, integrity, and honor Zijlstra-Shaw, Robinson[5] Evetts 2003. This project was considered an important contribution to defining the elements and meaning of contemporary medical professionalism at least in the American society (Marti-Ibañez 1990).

In a related important development, the American College of Physicians, the American Society of Internal Medicine, the American Board of Internal Medicine, and European Federation of Internal Medicine, established a Charter for Physician on medical professionalism in 2002. This important document listed three basic foundations of medical professionalism including, social justice, patient autonomy, and primacy of patient welfare, (General Medical Council 2001)[6] along with 10 professional responsibilities, that include: honesty with patients, professional competence, commitment to patients' confidentiality, improving quality and access to care, maintaining appropriate relationships with patients, scientific knowledge, maintaining trust, managing conflicts of interest, professional responsibilities and just distribution of finite resources.[1] As a result, the competence based curriculum, and professional training programs are being introduced and professionalism is made an integral part of undergraduate and postgraduate training and assessment programs. Some of these changes may be limited to some societies and cultures, whereas others are more prominent in others.

When medical professionalism is taught to medical students, it should reflect the underpinning social contract including placing the of patients 'interests above those of physicians (Cruess, 2006). The importance of a socio-cultural context of medical professionalism thus becomes more valuable and outstanding as voiced by the Physician Charter editor; "Does this document reflect the tradition of medicine in cultures other than those in the West, where the authors of the charter have practiced medicine?" (Blank et al. 2003). There is no universal truth about medical professionalism. Ho, Yu[7] challenged the Western framework of medical professionalism applicability and proposed a framework of professionalism reflecting the values and the cultural heritage of Taiwanese stakeholders (Irvine).[8] Many researchers suggested that medical professionalism needs a clear description that should be contextually linked to any culture (Van De Camp et al. 2004;

Wear & Kuczewski 2004; Hafferty 2006; Woodruff et al. 2008). Cultural backgrounds may theoretically add cultural specific elements to the concept of professionalism (Hafferty, 2006), but on the other hand these are herein shown to be very limited (Cruess et al 2010). The areas on the concept of professionalism are overlapping, therefore the consensus on professional characteristics for professionals is not yet validated.
The emphasis on conceptualization of professionalism in medical education across cultures has come in response to perceived differences in societal core values and community needs. While Eastern world values and beliefs are propelled by Confucian traditions in terms of group dynamics and dignified persona (Ho et al. 2011), The evolution and discourse of professionalism is more prominent in the Western culture (Cruess 2006). In some of the included studies, utilization of the Western concept of professionalism was literal (Akhund et al. 2014; Nishigori et al. 2014) and other studies (Ho et al. 2011; Chandratilake et al. 2012; Al-Eraky et al. 2014) included cited concepts from other sources (Cruess et al. 2002; Cruess 2006; Cruess et al. 2010). These citations brought different concepts on the influence of cultural traditions on medical professionalism.

Other investigators from non-Western cultures especially China and Saudi Arabia followed this trend Pan, Norris.[9] They all advocated that there is no professionalism framework that is comprehensive and applicable in all contexts. This study identifies three non-Western framework of professionalism; the aim is three folds 1) to describe the three frameworks and their culture specific elements. 2) To describe the commonalities among the three frameworks and 3) to describe the differences between them.

Methods

A narrative overview was used to realize the objectives of this study. A narrative overview reports the authors' findings in a condensed format that typically summarizes the contents of each article.[10] The main justification of using this method is the fact that we found only four articles that met the criteria. Second, it is most suitable when the authors intend to bring an important issue such as professionalism in non-Western cultures to light for stimulating discussion and try to answer a pending question. In our case we are trying to answer our research questions addressed earlier through conducting a comprehensive literature review, and identifying selection criteria of articles.

Literature search

Multiple methods was used in this review including: PubMed; Embase (an up-to-date database, PsychINFO, Educational Resources Information Centre (ERIC); Sociological

Abstracts; and Topics in Medical Education (TIMELIT), were covering the most important international biomedical literature from 1947 to the present day. PubMed is more relevant to our study which covers the literature starting from 1966. We limited our search on PubMed database from 2002-2014 because the 'Physician Charter' was established in that year. Table 3.1 showed the terms used for the search. References of all selected studies were subsequently hand-searched. Quantitative and qualitative research including systematic reviews, RCT, reports, journal articles was used for the purpose of the study. Table 3.2 showed the numbers of hits in the database. Two reviewers assessed the inclusion criteria of all selected studies by scanning the totals and the abstracts. The reference list of the articles was scanned to retrieve the further relevant studies enabling us to incorporate seminal work such as the Medical Professionalism. Subsequently, full text articles was retrieved and reviewed by the same two reviewers taking in consideration the risk of biases.

Table 3.1 Keywords Used in Search Method.

Key Terms Groups	Key Terms
Professionalism	Professional behavior, professional attitudes, professional role, profession, morals, ethics, values, social virtues.
Culture	Non-Western cultures, culture, across cultures, transcultural.
Professionals	Doctor, medical students, medical educator, medical professionals, medical registrar, medicine, postgraduate, practitioners, physician, general practitioner, and medical students, undergraduate students.

Table 3.2 Number of hits obtained in the database.

Recent queries in PubMed		
Search	**Query**	**Items found**
1	Search professionalism[Title]	2159
2	Search medical professionalism[Title]	234
3	Search (professionalism[Title]) AND cross-cultural[Title]	0
4	Search (medical professionalism[Title]) AND culture[Title]	1
5	Search (medical professionalism[Title]) AND cross-cultural[Title]	0
6	Search (professionalism[Title]) AND culture[Title]	12
7	Search (professionalism[Title/Abstract]) AND culture[Title/Abstract]	143

Inclusion criteria

Studies addressing medical professionalism in non-Western culture were selected based on the following selection criteria: (1) any type of original article on medical professionalism that recruited physicians, medical students, medical teachers, medical educators, and paramedical staff, and (2) research that defined medical professionalism and its dimensions across non-Western cultures, and (3) studies published in English language.

Exclusion criteria

Studies conducted in Western context, included non-medical/paramedical, and in non-English language were excluded.

Results

One hundred and forty four full-texts were shortlisted for further review, 131 studies were excluded due to its focus on non-medical professionalism. Only thirteen articles addressed professionalism in non-Western culture. From these thirteen studies only four studies had a unique non-Western framework which includes culture-specific elements. From these four studies, only three different frameworks were identified as the Chinese and the Taiwanese studies were both focusing on one framework. Table 3.3 presents the characteristics of the included studies. Boxes 1-3 describe the three frameworks. The other nine studies were excluded because they look at professionalism through a Western lens. Table 3.4 presents 24 attributes found in the three non-Western cultures. Only three attributes are common among the three frameworks, while twelve attributes are shared by at least two cultures. The remaining nine attributes are unique to each culture i.e. are found at least in one culture.

Table 3.3 Characteristics of Eligible Studies.

Country/Region	Authors (year)	Study objective	Method	Participants	Results	Remarks
Taiwan	Ho et al. (2011)	To build a framework for MP that focuses on socio cultural context.	Qualitative, used different techniques for reaching consensus.	91 Medical and allied personnel	Critical stakeholders reached consensus on a non-Western framework that integrated eight competencies. Integrity was considered most central to the framework for MP.	The Taiwanese framework emphasizes that socio cultural themes contextually impact MP.
China	Pan et al. 2013	To formulate a Chinese framework for MP.	Qualitative method used NGT	97 participants sorted into 13 professional groups discussed and ranked categories of professionalism	Analysis of ranked categories and meeting transcripts added four additional themes to pre-existing 8 categories of MP framework.	The Chinese framework on professionalism was developed with the basis of Confucian values that can be translated as: *humane love* and *public spiritedness*
Japan	Nishigori et al. 2014	To compare Bushido as a value system and the physician charter.	A qualitative survey of physicians.	422 physicians were asked about and commented on the seven virtues of Bushido still used in their practice	The traditional Bushido' virtues of Japanese samurai worriers were found relevant to the physician charter of MP.	Educators should keep abreast of Bushido's seven principle virtues and consider the impact of religion when teaching MP and practicing in Japan.
Saudi Arabia	Al-Eraky et al 2014	To build a framework for MP from an Arabian perspective	A qualitative survey using Delphi technique in three rounds	17 experts from multiple disciplines	Eight attributes of professionalism were groups in four themes (Gates): dealing with self, dealing with tasks, dealing with others and dealing with God. Self-accountability and self-motivation were interpreted as *taqwa* and *ehtesab* in Arabic.	The Arabian framework has more similarities than differences with Western culture. Some attributes were interpreted variably on the basis of 'faith', as a core value for Arabs.

Table 3.4 Commonalities and differences of attributes among the three Non-Western frameworks.

Attributes	Arabian Framework	Chinese Framework	Japanese Framework
Altruism/Benevolence/Compassion	√	√	√
Integrity /Honesty/Rectitude	√	√	√
Respect /Politeness	√	√	√
Accountability	√	√	
Commitment/Responsibility/Dutifulness	√	√	
Ethics	√	√	
Excellence	√	√	
Clinical competence	√	√	
Communication	√	√	
Discipline (self-awareness/self-motivation/self-regulation)	√	√	
Medical Knowledge/Health Promotion	√	√	
Teamwork	√	√	
Religion/Moral values	√	√	
Trustworthiness/Confidentiality	√		√
Honor	√		√
Role model	√		
Advocacy		√	
Equity		√	
Humanism		√	
Economic considerations		√	
Courage			√
Loyalty			√
Protection of patient rights		√	
Reflective practice	√		
Total = 24	17	18	7

Box 1. Framework from Chinese cultural perspective

From China's cultural perspective, Ho et al (2011)[7] framework consists of Stern's medical professionalism framework in the shape of a Greek temple and includes three basic principles (communication, clinical competence, and ethics), four pillars/columns (accountability, humanism, excellence, and altruism), and a beam (integrity), the beam across the top of the columns. Included blank columns are to be used for additional values for professionalism. They used the cultural concept of *Zizhong* (self-dignity and respect) which is associated with integrity in Chinese culture. The authors consider that to be respectful and self-dignified is a fundamental steps in professional development and placed it as a beam on the top of the supporting column. Although these attributes of medical professionalism are similar to Western culture, this framework derails from Stern as all participants agreed to add "integrity" relating to the concept of *Zizhong.* This framework is deeply embedded in cultural roots of the Taiwanese and Chinese belief system. The study of Ho and her coworkers included allied health professionals and members from the community to develop the concept of professionalism in their cultural context.

Pan et al. 2013, used the same concept. However, they integrated four additional categories of: teamwork, health promotion, self-management and economics. According to this study, eight categories offered a pre-existing framework, which included integrity, clinical competence, communication, humanism, ethics, altruism, accountability and excellence. These categories are similar to Ho and colleagues' framework (Ho et al. 2011) and Western-oriented cultures frameworks.

Box 2. The Arabian framework

The Arabian context can be perceived as the blend of culture, traditions, beliefs and behaviors that are being practiced by nations of Arabian countries in the Middle East, where Arabic is the official language and Islam is the religion of majority of the population. Those behaviors and traditions are not necessarily derived from Islamic doctrines, but some common values have been accepted as the norm among populations of these countries. According to Barakat (1993), although there are differences in ethnic groups, tribes, local cultures and regional entities, the '*Arab world*' is a single, overarching society rather than a collection of several independent states. In Arabian context, Al-Eraky and colleagues (2014)[11] described the Four Gates model of medical professionalism in the context of Arabian culture that is based on the value of Islam. Eight professional attributes were grouped into four themes which include: 1) dealing with self that includes two attributes of self-awareness (*taqwa*) and self-management (*ehtesab*), 2) dealing with tasks that deals with excellence, commitment to professional development and reflective practice, 3) dealing with others that reflects attributes of respect for patients, colleagues and students, and maintaining professional confidentiality, and 4) dealing with Allah (God), a different stream in the literature that reflects attributes of self-accountability and self-motivation that link with Allah defined it as a reward professionals receive from Allah, not from people.

Box 3. Framework from Japanese cultural perspective

With respect to Japanese cultural context, Nishigori, Harrison[12] described the concept of Bushido as a value system that means, "the way of the warrior," is corresponding to professionalism. This concept symbolizes a Japanese code of personal conduct extracted from the ancient warriors of Samurai. Seven principal virtues were grouped in the framework of Bushido are rectitude (*gi*), honesty (*sei*), benevolence (*jin*), politeness (*rei*), courage (*yu*), honor (*meiyo*), and loyalty (*chugi*). Rectitude (*gi*) represents the way a person thinks, decide, and behave based on reason, without wavering. It is the first attribute considered as the most important attribute of the Samurai. Courage (*yu*), is the second virtue which is culture specific to Japanese framework means the spirit of bearing and daring, in other word , how one stands, walks, behaves, and doing the appropriate acts when facing danger. Benevolence (*jin*), as a third virtue combine the concepts of love,

sympathy, and pity. It is valued as the highest attribute in the soul of human. It has been translated by medical practice as “medicine as a benevolent art.” The Japanese have considered loyalty (*chu-gi*) to the interests and needs of the group such as hospital staff and family and. They place the needs of group’s above individual interest and needs. Therefore, Bushido combined the interests of family and its members.

Discussion

In this section we will discuss first the three frameworks followed by discussion of commonalities and differences among them.

The Chinese framework, added new categories of professionalism in terms of self-dignity, team work, health promotion and self-management to the conceptualization of professionalism. The strength of Pan et al.'s (2013) framework is that multidisciplinary expert groups using Nominated Group Technique (NGT) prioritized social and cultural attributes of medical professionalism which can benefit healthcare providers not only in China but also in other Asian cultures.

The Four-Gates Model in the Arab culture may work for faith-driven societies, but not for non-Muslim Arab students or teachers, or in institutions with humanistic values. The Four-Gates model suggests a move from the classical perception of medical professionalism as a short list of standalone attributes, to link them in a structural pattern of connected professional qualities as coupled in four logical domains (Gates).

Instead of using self-accountability, Al Eraky et al. (2014), introduced the term *taqwa;* in professionalism, an intrinsic sense of doctor for action and its consequences because they are answerable to Allah. For self-motivation a new construct of *ehtesab* in which doctors perform their best in teaching, learning and research and in return expect reward from Allah was introduced. Interestingly, the center of attention of the Four-Gates is the individual, which is reflected with the presence of ‘self’ in four out of eight attributes. Medical professionalism starts by preparing professionals – themselves – to work in a complex healthcare system. In summary, although the last three themes each consisting of six attributes are similar to frameworks of Western culture, this study on the Arabian cultural perspective linked the concept of social accountability with divine accountability. As indicated above the universal attributes of professionalism are interpreted differently in various contexts, based on the local norms and belief systems.

In regards to the Japanese culture, the attributes of a frequently referenced professionalism Western guide such as the Physician Charter were compared to the Bushido concept. They described the similarities and differences between the attributes including the effect of religion, traditions and virtues. The researchers suggested that in Japanese culture Bushido's seven principle) were applicable to medical professionalism and were fairly comparable to Physician Charter (Nishigori et al. 2014). The notable differences pointed out was the omission of several commitments such as rectitude, courage, politeness and honor in the Physician Charter that are mentioned and discussed in Bushido, as the Charter described medical professionalism, whereas Bushido explained generally as a code of conduct for the society. Prominent of other differences is the concept of patient autonomy of the individual which is omitted in the Bushido framework but is highly regarded in Western culture.

The studies addressing non-Western perspectives on professionalism thus identified several key similarities and differences regarding professional attributes of medical practitioners. These similarities and differences will be addressed in more details in the next sections.

Commonalities of professionalism cited in non-Western studies

These three frameworks are driven and deeply influenced by cultural norms such as fait in Arab culture and tradition in Chinese and Japanese cultures. A total of 24 attributes were identified from the three articles (Table3.4). Many concepts were comparable among the studies addressing non-Western context, but also very much comparable to Western culture , such as altruism, honesty and integrity, respect, accountability, teamwork, ethics, clinical competence ,commitment and communication and protection of patient's rights (Chiu et al. 2010; Adkoli et al. 2011;[7] Pan et al. 2011; Akhund et al 2014; Al-Eraky 2014;[12] and patients[13] Chandratilake et al. 2012; Leung et al. 2012; Akhund et al. 2014). Notably, in the Eastern world (Al Eraky et al. 2014; Nishigori et al. 2014) respect has a strong connectivity and influences not only in teaching but also practicing professionalism in medical settings. This is also true in the Western world, but its meaning for teaching and patient care is different in the contemporary Western society. In the non-Western society the professional relationship between a medical teacher and a student and likewise, the doctor and the patient is based on the paternalistic approach where decisions are usually made by professionals (Cruess et al. 2010), which has been abandoned as common practice in the Western world, moving towards shared decision making. In summary, elemental similarities are common denominators in all three non-Western frameworks of professionalism.

Differences of professionalism cited in non-Western studies

Several important aspects described in three non-Western frameworks were notably absent from the Western frameworks. The commonalities stated earlier by the deep cultural influence on the three frameworks are also a source of major differences between them due to the fact that each culture has its own unique values that are reflected in MP. The main differences between the three frameworks are related to culture and prioritization as well as interpretation of attributes. For instance nine attributes are not common or shared by the three frameworks.
Self-dignity and respect derived from the *Zizhong* culture concept by Ho et al. (2011) equates with integrity; Al-Eraky and associates (2014) introduced a unique dimension to the framework of medical professionalism in Arabian culture in the form of dealing with Allah (God), and under the umbrella of this theme, self-accountability (*taqwa*) and self-motivation (*ehtesab*) were described. Pan et al.'s (2013) and Ho et al's (2011) framework differs from the other two models in terms of four additional themes, especially health promotion, self-management, team work and economic consideration in promoting professionalism.

While comparing the differences between the non-Western studies this review found the attributes of advocacy, equity, humanism and economic considerations essential attributes of professionalism in the region of China, Hong Kong and Taiwan whereas in Saudi Arabia and Japan's culture these attributes are not considered essential elements of medical professionalism. These similarities and differences described in the previous sections relate to social, economic and cultural backgrounds.

Practical implication

Based on the findings and the effect of culture on professional attributes, the study may propose an extended framework of professionalism to include socio-cultural factors as background variables such as faith in Arabic culture and Bushido in Japanese culture; these background factors positively or negatively influence professional attributes. The prioritization of the attributes reflects the importance to each culture. The proposed model may be completed by adding a third level which is the outcome of professional attributes on health indictors such as patient and provider satisfaction as well as better healthcare

This study provides strong evidence that professionalism is contextual, and therefore including culture specific elements in curricula and continuous professional development programs regarding teaching and assessing professionalism in medical education seems a logical consequence. Further research is however needed to develop and empirically test

the suggested extended model of professionalism and the impact on teaching and assessing professionalism in different contexts.

Limitations of the study

One of the limitations of this study is the utilization of narrative review as a method, This type of review which depends on few studies may bring an element of bias which affects generalization of findings to the universe 29-30, However we took all the measures to make it more objectives by carefully following all the steps of conducting an overview.

Conclusion

This narrative overview revealed four major findings. Firstly, only four studies attempted to develop a three culture-tailored non-Western framework for medical professionalism, (Nishigori, Harrison;[12] Al-Eraky et al 2014; Ho et al. 2011 and Pan et al. 2013; representing Japan, Arab world and China respectively were identified. Pan and colleagues (2013) extended the framework developed by Ho and associates (Ho et al. 2011). These studies provided culture specific elements in a *unique* conceptual framework of medical professionalism representing the region they originated from. Secondly, the three identified non-western frameworks have commonalities of universally-praised attributes, but they were interpreted differently in various cultures. For instance, integrity was relevant to *Zizhong* in Chinese Confucian values, while self-motivation and self-accountability were interpreted as *taqwa* and *ehtesab* in Arabian context. The differences thus concern the interpretation and prioritization of the attributes. Medical professionalism is context-specific. There is no single framework on professionalism that can be globally acknowledged. A culture-oriented concept of professionalism is necessary to understand what the profession is dedicated to and to incorporate the concept into the medical students' and physicians' professional identity formation. Finally, the authors propose an extended framework to include culture as background to attributes leading to an outcome on health care.

References

1. Foundation A, Foundation A-A, European Federation of Internal M. Medical professionalism in the new millenium: a physician charter. J Am Coll Surg. 2003;196(1):115-8.
2. Cruess RL, Cruess SR, Johnston SE. Professionalism: an ideal to be sustained. Lancet. 2000;356(9224):156-9.
3. Pellegrino ED, Relman AS. Professional medical associations: ethical and practical guidelines. JAMA. 1999;282(10):984-6.
4. Sohl P, Bassford HA. Codes of medical ethics: traditional foundations and contemporary practice. Soc Sci Med. 1986;22(11):1175-9.
5. Zijlstra-Shaw S, Robinson PG, Roberts T. Assessing professionalism within dental education; the need for a definition. Eur J Dent Educ. 2012;16(1):e128-36.
6. Good medical practice: the duties of a doctor registered with the General Medical Council. Medical education. 2001;35 Suppl 1:70-8.
7. Ho MJ, Yu KH, Hirsh D, Huang TS, Yang PC. Does one size fit all? Building a framework for medical professionalism. Acad Med. 2011;86(11):1407-14.
8. Irvine D. The performance of doctors. I: Professionalism and self regulation in a changing world. BMJ. 1997;314(7093):1540-2.
9. Pan H, Norris JL, Liang YS, Li JN, Ho MJ. Building a professionalism framework for healthcare providers in China: a nominal group technique study. Med Teach. 2013;35(10):e1531-6.
10. Green BN, Johnson CD, Adams A. Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. J Chiropr Med. 2006;5(3):101-17.
11. Al-Eraky MM, Donkers J, Wajid G, van Merrienboer JJ. A Delphi study of medical professionalism in Arabian countries: the Four-Gates model. Med Teach. 2014;36 Suppl 1:S8-16.
12. Nishigori H, Harrison R, Busari J, Dornan T. Bushido and medical professionalism in Japan. Academic medicine : journal of the Association of American Medical Colleges. 2014;89(4):560-3.
13. Akhund S, Shaikh ZA, Ali SA. Attitudes of Pakistani and Pakistani heritage medical students regarding professionalism at a medical college in Karachi, Pakistan. BMC Res Notes. 2014;7:150.

Chapter 4

High school versus graduate entry in a Saudi medical school – is there any difference in academic performance and professionalism lapses?

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Abstract

Background: King Saud bin Abdulaziz University for Health Sciences (KSAU-HS) was the first university in the Kingdom of Saudi Arabia offering both high school entry and graduate entry (GE) students into medical school. We compared the academic performance and professionalism lapses of high school entry and GE students who undertook the same curriculum and examinations in the College of Medicine, Riyadh, KSAU-HS.

Methods: Examination scores of 196 high school graduates and 54 GE students over a 4-year period (2010-2014) were used as a measure of academic achievement. For assessment of professionalism lapses, we compared the number of warning letters in both streams of students.

Results: In some pre-clinical courses, high school entry students performed significantly better than GE students. There was no significant difference in academic performance of high school entry and GE students in clinical rotations. GE students had a significantly greater number of warning letters per student as compared to high school entry students.

Discussion: This is the first Saudi study to compare the performance of high school entry and GE students in a medical school. Overall, both streams of students performed equally well with high school entry students performing better than GE students in a few pre-clinical courses. We compared professionalism lapses and found an increase in number of warning letters for GE students. More studies are needed to evaluate if there are differences in other assessments of professionalism between these two streams of students.

Background

There has been a substantial increase in the number of graduate entry (GE) programs in medical schools over the last decade in the UK, Ireland and Australia. The most recent study comparing high school and GE students was reported from Ireland and found that GE students performed at least as well, or even better than high school entry students in both bioscience knowledge and clinical assessments.[1] In a study from Australia, Reid et al.[2] found that both GE and high school entry medical students performed similarly on clinical assessments. The same study group found that in pre-clinical assessments, GE students had a marginal academic performance advantage.[3] In a large-scale UK study to compare the performance of GE and school-leaver (high school) entry medical students, Shehmar et al.[4] found that high school entry students performed better on clinical examinations midway through training, but there was no significant difference in the final clinical exam. The study also showed no significant difference between the groups in performance of the Phase I (basic sciences knowledge) exam. A study from the University of Nottingham, UK found that GE students outperformed high school entry students in the initial clinical phase, but had a lower performance on most of the subsequent knowledge-based exams.[5] Finally, another study from the UK reported that on average the academic performance of GE medical students was better than high school entry students.[6] Based on this literature, there is no clear advantage of one group over the other in terms of academic performance. To the best of our knowledge, the academic performance of high school entry and GE students has not been studied in the Kingdom of Saudi Arabia or in the Gulf region.

GE into medical school was first introduced in Saudi Arabia at King Saud bin Abdulaziz University of Health Sciences (KSAU-HS) in 2005. Moreover, KSAU-HS was the first specialized university dedicated for health sciences training in the Gulf region. It began as one main branch in Riyadh, and there are now two more branches in Jeddah (Western Region) and Al-Hasa (Eastern Region). When the College of Medicine, Riyadh (COM-R) opened in 2005, admission was only given to GE students; in fact, the first five batches of medical students were only GE students. In 2007, high school entry students were admitted to the COM-R. GE students complete an introductory 4-month curriculum followed by the 4-year medicine course (which includes 2 years of pre-clinical courses structured as systems-based blocks followed by approximately 2 years of clinical rotations). High school entry students complete a 6-year curriculum that includes a 2-year pre-professional programme followed by the 4-year medicine programme. Their 4-year medicine programme is identical to the 4-year programme that GE students take. Thus these two cohorts of students undertake the same curriculum and are subjected to the same assessment exams (written, OSPEs and OSCEs).

While other studies have compared academic performance between high school entry and GE students, we also sought to address any differences in professionalism lapses between

these two groups of students. The definition of professionalism and the best practices for its assessment remains complex.[7] Common elements of professionalism include altruism, respect for others, honour, integrity, ethical and moral standards, accountability, excellence, and duty. Assessment of professionalism must be integrated across the medical course using multiple tools.[8] A major assumption in medical education is that professional students become professional physicians.[9] In two landmark studies, unprofessional behaviour in medical school was associated with subsequent disciplinary action against practicing physicians.[9-10] Our research objectives were to compare the academic performance of high school graduates and GE medical students in the COM-R, and to compare professionalism lapses between these two streams of students.

Methods

A retrospective quantitative cohort study was carried out to compare academic performance and professionalism lapses of high school entry and GE entry students in the COM-R, KSAU-HS over a 4 year period (2010-2014). The study included 3 cohorts of students in which there were both streams of students (high school entry and GE). These cohorts of students were all males and included students in Batches 7, 8, and 9. Female students were enrolled in the COM-R from Batch 8; however as their numbers were small and only high school entry, their data was not included in the analysis. Academic Affairs in the College of Medicine provided the final grades (given in percentages) for the students. Academic performance was compared for pre-clinical courses (all batches) and clinical rotations (Batches 7 and 8). At the time of the conclusion of the study, Batch 7 students had graduated in 2014, Batch 8 students had not completed all clinical rotations and Batch 9 students were in their first year of clinical rotations. The pre-clinical courses for both streams of students included Foundation studies, Musculoskeletal Sciences, Respiratory Sciences, Hematology, Cardiovascular Sciences, Medical Elective I, Neurosciences Vision and Behavior, Endocrine, Nutrition & Reproductive Health, Urology & Renal, Gastroenterology & Nutrition, and Oncology & Palliative Care. The final grade for these courses (except Medical Elective I) included results from mid-term and final examinations (written) as well as OSPEs and OSCEs. The clinical rotations in which we had data for Batches 7 and 8 included Surgery I, Medicine I, Pediatrics, and Family & Community Medicine. The assessment for these rotations also included written examinations and OSCEs as well as the Mini-Clinical Evaluation Exercise (Mini-CEX). Data supplied to the researchers consisted of final grades classified by stream (high school entry vs. GE) without any names of students. The grades were reported as percentages and they were obtained from gathering examination results of each student in each block.

Student Affairs provided the number of warning letters students received by stream of student. Warning letters are given if students violate the code of ethics (for example: excessive absences, smoking on campus, signing an attendance sheet and then leaving, etc.). Warning letters data was available for both streams of students in Batches 7 and 8.
For academic performance, the mean final percentage for each block or clinical rotation was calculated for each stream of students. Data analysis was performed with SPSS version 22 (IBM Corporation, USA). The independent samples t-test compared the means between the two unrelated groups on the same continuous dependent variable. Minitab version 17 was used to perform the test of equality of the Poisson rates (mean) for warning letters. Significant differences were identified at $p<0.05$. Approval for our study was obtained from the Research Office at King Abdullah International Medical Research Center, Ministry of National Guard - Health Affairs as well as the Dean, COM-R, KSAU-HS.

Results

High school entry students accounted for 196 (78%) of the sample as compared to 54 (22%) graduate entry (GE) students (Table 4.1). Virtually all of GE students had Bachelor's degrees in health science fields including clinical laboratory sciences, pharmacy, respiratory therapy, etc. In the pre-clinical phase, there was no significant difference in the overall percentage grade between high school entry and GE students. However, the percentage grade for high school entry students was significantly higher than GE students in 3 courses (Foundation Studies, Urology & Renal, and Gastroenterology & Nutrition blocks) (Table 4.2). There was no significant difference in academic performance for four clinical rotations in which there were 118 and 34 high school entry and GE students, respectively (Table 4.3). Warning letter data was obtained for Batch 7 and 8 students, and 105 students (69%) received at least one warning letter. The average number of warning letters per student was 10.15 for high school entry students and 14.91 for GE students, which was statistically significant (Table 4.4) ($p<0.001$).

Table 4.1 Number of High School Entry and Graduate Entry Students in Each Cohort.

	Cohort			
	1 (Batch 7)	**2 (Batch 8)**	**3 (Batch 9)**	**Total**
High school entry	42	76	78	196
Graduate entry	18	16	20	54

Table 4.2 Mean Percentages and Standard Deviations (SDs) of High School Entry and Graduate Entry Students in Pre-Clinical Courses.

Course	High School Entry Students, N=196		Graduate Entry Students, N 54			
	Mean, %	SD	Mean, %	SD	p-value	Cohen's *d*
Foundation Studies	81.3	7.2	78.2	7.0	**0.01**	0.44

Musculoskeletal Sciences & Substance Abuse	79.0	7.7	77.3	7.3	0.13	0.23
Respiratory Sciences	81.7	7.4	81.5	7.3	0.80	0.03
Hematology	83.9	7.2	84.1	8.6	0.87	0.03
Cardiovascular Sciences	83.0	7.6	81.2	6.6	0.12	0.25
Neurosciences, Vision & Behavior	82.3	8.0	80.4	7.0	0.10	0.25
Endocrine, Nutrition & Reproductive Health	81.9	8.5	79.6	7.7	0.09	0.28
Urology & Renal	85.2	5.7	82.7	7.0	**0.02**	0.39
Gastroenterology & Nutrition	82.6	7.0	80.4	6.3	**0.04**	0.33
Oncology & Palliative Care	85.8	6.2	85.2	5.7	0.48	0.10
Overall percentage in pre-clinical courses	82.7		81.1		0.12	

Table 4.3 Mean Percentages and Standard Deviations (SDs) of High School Entry and Graduate Entry Students in Clinical Rotations.

Clinical Rotation	**High School Entry Students, N = 118**		**Graduate Entry Students, N= 34**			
	Mean, %	**SD**	**Mean, %**	**SD**	**p-value**	**Cohen's *d***
Medicine I	85.1	5.8	84.9	5.9	0.81	0.03
Surgery I	81.5	6.3	80.5	5.3	0.37	0.17
Pediatrics	85.4	4.7	84.0	5.5	0.15	0.27
Family & Community Medicine	83.3	4.9	81.6	4.4	0.06	0.37
Overall percentage in clinical rotations	83.8		82.8		0.46	

Table 4.4 Warning Letters for High School Entry and Graduate Entry Students

	High school entry students	**Graduate entry students**	**p-value**
Average number of warning letters per student	10.15	14.91	<0.001

Discussion

Our results show that high school entry students performed significantly better than graduate entry (GE) on a few pre-clinical courses, with no significant difference in academic performance between the two groups in clinical rotations. Our study also compared some professionalism lapses between these two groups of students and we found a significant increase in the number of warning letters per student for the GE stream.

Our finding of essentially equal academic performance between high school and GE students is supported by other recent studies conducted in UK, Ireland, and Australia.[1-6]

While there are now several studies comparing academic performance of high school entry and GE students into medical school, our study was the first to look at some professionalism lapses between the two streams of students. We found that GE students received a significantly higher number of warning letters as compared to high school entry students. This finding is somewhat surprising as GE students are considered to be more mature than non-graduate medical students.[11] In addition, one study focusing on the attitudes towards professionalism in these two groups of students found that GE students ascribed greater importance to various aspects of professionalism across personal characteristics, interaction with patients and social responsibility categories.[12] In our medical school, GE students were the minority and they may feel more "alienated" in the medicine programme.[13] Furthermore, though GE students are expected to be more mature, there may be other factors like family responsibilities, stress and burnout that have contributed to our finding of more professionalism lapses observed in this group. Further research is needed to assess these factors.

There are several strengths of our study. First, this was the first study in Gulf region to compare academic performance of high school and GE students. We used direct comparison of performance for both groups of students who undertook the same curriculum and same examinations. Furthermore, while other studies compared academic performance, our study was the first to evaluate differences in professionalism lapses between these two groups of students. There are limitations of this study. The main limitation of this study is the small number of high school (196) and GE (54) students limiting the generalizability of our results. In addition, only male students were included in the analysis as female students started from Batch 8 but there were only high school entry students in that cohort. Finally, the assessment of professionalism is more complex than simply the number of warning letters per student, and other professionalism measures are needed to compare professionalism between the two groups.

Conclusions

High school entry and GE medical students perform equally well on clinical rotations, with high school entry students performing significantly better on some pre-clinical courses. There was a significant difference in number of warning letters per student between the two groups, with GE students receiving a higher number as compared to high school entry students. Further studies are needed to evaluate whether differences exist between high school and GE students on other assessments of academic performance (including during residency training and beyond) and on other assessments of professionalism..

References

1. Byrne AT, Arnett R, Farrell T, Sreenan S: Comparison of performance in a four year graduate entry medical programme and a tradiational five/six year programme. BMC Med Educ 2014;14:248.
2. Reid KJ, Dodds AE, McColl GJ: Clinical assessment performance of graduate- and undergraduate-entry medical students. Med Teach 2012;34:168-171.
3. Dodds AE, Reid KJ, Conn JJ, Elliott SL, McColl GJ: Comparing the academic performance of graduate- and undergraduate-entry medical students. Med Educ 2010;44:197-204.
4. Shehmar M, Haldane T, Price-Forbes A, Macdougall C, Fraser I, Paterson S, Peile E: Comparing the performance of graduate-entry and school-leaver medical students. Med Educ 2010;44:699-705.
5. Manning G, Garrud P: Comparative attainment of 5-year undergraduate and 4-year graduate entry medical students moving into foundation training. BMC Med Educ 2009;9:76.
6. Calvert MJ, Ross NM, Freemantle N, Xu Y, Zvauya R, Parle JV: Examination performance of graduate entry medical students compared with mainstream students. J R Soc Med 2009;102:425-430.
7. Hodges BD, Ginsburg S, Cruess R, Cruess S, Delport R, Hafferty F, Ho MJ, Holmboe E, Holtman M, Ohbu S, Rees C, Ten Cate O, Tsugawa Y, Van Mook W, Wass V, Wilkinson T, Wade W: Assessment of professionalism: Recommendations from the Ottawa 2010 Conference. Med Teach 2011;33:354-363.
8. O'Sullivan H, Van Mook W, Fewtrell R, Wass V: Integrating professionalism into the curriculum: AMEE Guide No. 61. Med Teach 2012;34:e64-77.
9. Papadakis MA, Teherani A, Banach MA, Knettler TR, Rattner SL, Stern DT, Veloski JJ, Hodgson CS: Disciplinary Action by Medical Boards and Prior Behavior in Medical School. NEJM 2005;353:2673-2682.
10. Papadakis MA, Hodgson CS, Teherani A, Kohatsu ND: Unprofessional Behavior in Medical School Is Associated with Subsequent Disciplinary Action by a State Medical Board. Acad Med 2004;79:244-249.
11. McCrorie P: Graduate students are more challenging, demanding, and questioning. BMJ 2002;325:676.
12. O'Flynn S, Power S, Horgan M, O'Tuathaigh CMP: Attitudes towards Professionalism in Graduate and Non-graduate Entrants to Medical School. Educ Health 2014;27:200-204.
13. Sefton AJ: Graduate entry to medical school. Med Educ 2004;38:1032-1034.

Chapter 5

Teaching Clinical reasoning through hypothetico-deduction is (slightly) better than self-explanation in tutorial groups: An experimental Study

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Abstract

Background: Self-explanation while individually diagnosing clinical cases has proved to be an effective instructional approach for teaching clinical reasoning. The present study compared the effects on diagnostic performance of self-explanation in small groups with the more commonly used hypothetico-deductive approach.

Methods: Second-year students from a six-year medical school in Saudi Arabia (39 males; 49 females) worked in small groups on seven clinical vignettes (four criterion cases representing cardiovascular diseases and three 'fillers', i.e. cases of other unrelated diagnoses). The students followed different approaches to work on each case depending on the experimental condition to which they had been randomly assigned. Under the self-explanation condition, students provided a diagnosis and a suitable pathophysiological explanation for the clinical findings whereas in the hypothetico-deduction condition students hypothesized about plausible diagnoses for signs and symptoms that were presented sequentially. One week later, all students diagnosed eight vignettes, four of which represented cardiovascular diseases. A mean diagnostic accuracy score (range: 0–1) was computed for the criterion cases. One-way ANOVA with experimental condition as between-subjects factor was performed on the mean diagnostic accuracy scores.

Results: Students in the hypothetico-deduction condition outperformed those in the self-explanation condition (mean = 0.22, standard deviation = 0.14, mean = 0.17; standard deviation = 0.12; $F(1, 88) = 4.90$, $p = 0.03$, partial $\eta^2 = 0.06$, respectively).

Conclusions: Students in the hypothetico-deduction condition performed slightly better on a follow-up test involving similar cases, possibly because they were allowed to formulate more than one hypothesis per case during the learning phase.

What this paper adds

Medical education places much value on the development of students' diagnostic competence. Many schools now offer clinical reasoning courses early in the curriculum, but there is little empirical research on the approaches commonly used for the teaching of clinical reasoning. This experiment compared the effectiveness of two teaching approaches: self-explanation and hypothetico-deduction. The latter asks students to hypothesize about plausible diagnoses for clinical findings that are presented sequentially. Despite being very common, its effectiveness has rarely been investigated. The hypothetico-deduction approach worked slightly better than self-explanation to foster students' diagnostic performance. Possible explanations for the findings are discussed.

Introduction

The acquisition of competence in the skill of diagnostic reasoning is perhaps the most important task a medical student is confronted with, a task that is fraught with difficulties. Not only does the student have to learn to distinguish be- tween 700+ different diseases, these diseases tend to present in quite idiosyncratic ways in patients. In addition, contextual influences, such as time pressure,[1] patients' disruptive behaviours[2] and a variety of cognitive biases such as availability bias,[3] seem to add to the difficulty of arriving at the right diagnosis. The teaching of clinical reasoning is therefore an inherently challenging endeavour.

Teaching clinical reasoning has been traditionally left to the clinical rotations, intuitively the best place to learn these skills. However, this maxim is not true to the same extent as it was for a long time, as research findings and anecdotal evidence suggest,[4] Supervision and feedback are often suboptimal in clinical rotations, and students tend to be ex- posed to a patient population that does not replicate the range of health problems that they will encounter in professional life.[5] In response to these developments, medical schools have begun to establish clinical reasoning courses earlier in the curriculum, during which students become acquainted with the art and science of diagnostic reasoning by practicing with clinical problems. Early examples concern employing simulated patients for this task. More recent additions involve the use of high-fidelity virtual patients presented online. Both are however expensive to develop and execute and have uncertain advantages over paper vignettes.[6,7] Written clinical cases have therefore been extensively used, with a variety of instructional approaches being employed to teach clinical reasoning. Schmidt and Mamede have recently reviewed paper-based approaches that are currently used (or proposed).[4] They distinguish between approaches on the basis of several dimensions, one of which is of interest for the present study: a distinction between cases unfolding in a sequential fashion (the 'serial- cue' approach) and 'whole-case' approaches. The basic

difference between these two approaches is whether the case information is disclosed step-by-step or the entire case is available from the start. The former ('serial-cue') involves 'hypothetico-deduction', a way of reasoning resembling the diagnostic process of physicians[8] Information about the patient only becomes sequentially available in the course of a student's engagement with a case. Usually the patient's chief complaint is presented and the students propose di- agnostic hypotheses and deduce potential consequences, in terms of findings they would expect if the hypotheses were correct. Additional information is disclosed as the students progress through this process.[9-11] On the other hand, the 'whole-case' approach presents the case in full before students become involved with it. Schmidt and Mamede's review[4] seems to suggest that whole-case approaches are generally more effective than serial-cue approaches. How- ever, their evidence was based on a limited number of studies.[12]

Among the whole-case approaches, a rather promising method in the teaching of clinical reasoning is *self-explanation.*[13] Chamberland and colleagues[14,15] presented cases to advanced students and asked them, in addition to diagnosing these cases, to explain the signs and symptoms in terms of their underlying pathophysiology. A control group was simply asked to diagnose the same cases. The aim was to investigate whether self-explanation would foster students' ability to distinguish between diseases that could explain a particular clinical presentation (for example, possible diagnoses for a patient presenting with chest pain and shortness of breath). The assumption underlying self-explanation was that by reactivating pathophysiological knowledge previously learned, the pathophysiological explanation would act as the underlying fabric more clearly tying together the signs and symptoms of these cases.[16] This would in turn lead to better diagnostic performance on similar cases presented at a later date. Chamberland found evidence showing just that, however only for cases that the students were not very familiar with.

The Chamberland studies presented cases to individual students to assess their impact. Such an approach, while theoretically important, is not amenable to introduction into an actual medical curriculum. In the Chamberland studies, for instance, each student had his or her own facilitator, who was tasked with encouraging the student to think aloud while dealing with the case. In actual programs, however, students would probably be practicing in the presence of peers or in small groups. What would happen if *groups* of students were to work on cases? There is much evidence that having groups of students collaborate adds to the individual members' learning and performance.[17] Such superior performance emerges because groups encourage individual students to elaborate on their prior knowledge (which facilitates further learning) and in addition to learn from each other.

The purpose of the present study, then, was to assess the effects of a self-explanation approach in small groups, relative to a hypothetico-deductive approach, on students' performance in the diagnosis of the same clinical cases. Based on the previous studies by

Chamberland and a study by Nendaz,[12] our hypothesis was that the self-explanation group would do better than the hypothetico-deduction group on a test with similar cases. To test this hypothesis, groups of six students either processed seven cases through self-explanation or via hypothetico-deduction. One week later, they were presented with eight new cases (four of which were directly relevant to the cases processed during the previous learning phase) which they had to diagnose. The mean number of accurate diagnoses was taken as a measure of the quality of learning taking place in the learning phase.

Methods

Design

The study consisted of two phases: a learning phase and a delayed diagnostic performance test administered 1 week later. In the learning phase, participants in small groups of approximately six discussed and diagnosed seven clinical cases under two different experimental conditions. Students were randomly assigned to the conditions of the experiment. Students in the *hypothetico-deduction* condition were presented with case information in a sequential fashion, had to provide tentative hypotheses, test these hypotheses as more information became available, and discuss their findings in small groups. The students in the *self-explanation* condition were presented with the whole case and were asked to ex- plain the signs and symptoms in terms of their underlying pathophysiology in small groups, and provide a diagnosis as well.

The test required candidates to diagnose a set of eight new clinical cases, of which four criterion cases represented new exemplars of the clinical presentations encountered in the learning phase and four represented “fillers” (cases of different diseases used to decrease the chance that participants would easily recognize the new set of cases as representing the diseases seen in the learning phase).

Participants

All 188 second-year medical students at King Saud bin Abdulaziz University Medical College, in Riyadh, Saudi Arabia, a six-year medical school, were invited to participate in this study. We recruited Year 2 students because, at this point in their training, they have been exposed to theoretical knowledge about diseases but not yet seen any patients. Written consent was obtained from all students involved. They were promised that data would be analyzed anonymously.

Ethical approval for the study was given by King Abdullah International Medical Research Center (KAIMRC) Riyadh, Kingdom of Saudi Arabia. The study was carried out in accordance with the Declaration of Helsinki.

Materials

Two sets of different clinical cases were used in the study, one for each phase (See Table 5.1 for the diagnoses involved). Each case consisted of a half-page description of a patient's medical history, present complaints, findings of a physical examination and results of laboratory tests. See Table 5.2 for an example of such a case. The cases were based on real patients and had been used in previous studies.[15] Part of the cases consisted of cardiovascular diseases, another part of unrelated diseases (filler cases). The former were the criterion cases to be considered for the primary analysis (because the instructional approaches aim at increasing students' ability to distinguish between diseases that are part of the differential diagnosis of a particular clinical presentation). The latter were included to reinforce the idea that both learning and test phase were clinical reasoning exercises and are therefore not relevant for the primary analysis.

Table 5.1 Diagnoses of the cases used in the different phases of the study

Learning phase		**Test phase**	
		Case 2.0 -	Stomach cancer (Filler)
Case 1.1 -	Acute myocardial infarction with heart failure	Case 2.1 -	Chronic CAD, with decompensated heart failure by anaemia
Case 1.2 -	Community-acquired pneumonia (Filler)	Case 2.2 -	Acute pyelonephritis (Filler)
Case 1.3 -	Aortic stenosis with heart failure	Case 2.3 -	Chronic mitral insufficiency with secondary heart failu
Case 1.4 -	Nephrotic syndrome (Filler)	Case 2.4 -	Meningoencephalitis (Filler)
Case 1.5 -	Hypertensive cardiomyopathy	Case 2.5 -	Hypertensive cardiomyopathy
Case 1.6 -	Acute viral hepatitis (Filler)	Case 2.6 -	Acute appendicitis
Case 1.7 -	Alcoholic cardiomyopathy	Case 2.7 -	Viral myocarditis
		Case 2.8 -	Rheumatoid arthritis (Filler)

Table 5.1 A case of acute myocardial infarction with heart failure

A 59-year-old businessman presents in the emergency department with severe dyspnoea. For the last 2 months, the patient has noted increasing shortness of breath: at first on climbing the stairs, and since last week at the least effort. The last two nights were particularly difficult, the patient experiencing shortness of breath even when lying down which forced him to sleep sitting up in a chair. He did not notice any cough or sputum. He used a salbutamol inhaler, which he uses as needed for asthma, without result. In the last 24 h he has also noted 4–5 episodes of tightness of the chest, of moderate intensity, lasting 5 to 10 min. No palpitations or syncope. He had a cold last week, which resolved spontaneously. Medical history: Hypertension for some 20 years, apparently well controlled with diltiazem 240 mg daily. Seasonal asthma, for which he periodically takes steroids, using a dosing inhaler, and salbutamol. The patient smokes ½ pack of cigarettes/day; he reports a healthy diet
Physical examination: BP 100/60, steady pulse 105/min; the patient is clammy; RR 28/min, dyspnoea at rest with saturation of 88% on arrival—ambient air—and 92% using nasal cannula at 2 l/min; oral temperature 36.5. Jugular veins not distended. Heart sounds are normal, with presence of a B3. Presence of a systolic murmur noted, 2/6 at the apex radiating towards the armpit. On pulmonary examination, crackles noted bilaterally in the lower thirds and wheezes noted on expiration. The abdomen is normal. The lower limbs are normal
Laboratory results: Blood count, electrolytes, creatinine and glycaemia are normal. The ECG shows q waves (inferior) and inversion of the T wave from V2 to V6 with displacement of 2 mm in V3, V4, V5. Elevated troponins, 0.12. Chest X-ray showed perihilar haze, septal lines and a slight right pleural effusion

Procedure

Learning phase

The learning phase required the students to diagnose seven clinical cases. The cases were presented through PowerPoint slides in one of two randomized orders. Participants were randomly assigned to either the self-ex- planation condition or the hypothetico-deduction condition by using the list of students enrolled in the second year of the program. Subsequently, they were subdivided in groups of six, each with a facilitator who was a member of the academic staff. Prior to the study, the facilitators attended a 2-hour training session aimed at familiarising them with the study and ensuring uniformity of the procedure. The facilitator's task was to take care that the procedure as de- scribed below was followed meticulously. He or she did not provide feedback or otherwise interfere with the learning. Each student was also presented with a response booklet with blank pages in which he or she was asked to make notes.

In the self-explanation condition, once the case was presented, the students were given the following instructions: 1) Please read the case quickly. 2) Write down here one or more diagnoses that come to mind. 3) Write down in bullet points which pathophysiological process may have caused the signs and symptoms in this case. 4) Now discuss your ideas about the pathophysiology of the case with your colleagues. 5) What is your final diagnosis? The first three steps were taken individually. In step 4, students had to explain to each other how the signs and symptoms in the case were produced by the underlying pathophysiology. In step 5, they were to agree on a most likely

diagnosis. After having reached an agreement, the next case was presented on screen. Students did not receive feedback. The steps taken individually required written responses, whereas the other steps demanded only verbal reporting.

In the hypothetico-deduction condition, each case was presented in sequential fashion: history, physical examination, and laboratory test results would appear only after students followed the relevant parts of the instructions: History: 1) Write down here one or more diagnoses that come to mind while reading the history. 2) What further information would you need to test these diagnostic hypotheses? 3) Now discuss your ideas with you colleagues. Physical examination: 4) Write down here one or more diagnoses that come to mind while reading the physical examination information. 5) What further information would you need to test these diagnostic hypotheses? 6) Now discuss your ideas with you colleagues. Laboratory tests: 7) Write down here one or more diagnoses that come to mind while reading the laboratory data. 8) What is your final diagnosis? 9) Now discuss this conclusion with your colleagues. Steps 3, 6, and 9 required students to discuss ideas with their col- leagues; the other steps were taken individually. As in the self-explanation condition, the steps taken individually required written responses, whereas the other steps demanded only verbal reporting. After completing a case, the next case was presented sequentially. Students were allowed to take as much time as they needed, but facilitators were instructed to spend no more than an hour on the seven cases. Time was maximized for each case in each condition. No significant differences in time emerged.

Test phase

One week after the training phase, the students received, under examination conditions, a booklet with eight cases, four of which described a cardiovascular condition (criterion cases) and five were filler cases. Students were requested to read each case and write down the most likely diagnosis. At the end of the test phase, students were debriefed with regard to the purpose of the experiment.

Data analysis

The diagnoses provided by the participants for the criterion cases in the test phase were evaluated as correct, partially correct or incorrect, receiving scores of 1, 0.5, or 0 respectively. The diagnosis was considered correct whenever the core correct diagnosis of the case was provided (e.g. ‘myocarditis’ in a case of viral myocarditis). When the core diagnosis was not given, but one component of the diagnosis was mentioned, the diagnosis was considered partially correct (e.g. ‘mitral insufficiency’ in a case of chronic mitral insufficiency with secondary heart failure). When the participant’s response did not fall into one of these categories, the diagnosis was considered incorrect. Three experts in internal medicine (G.A.C., M.M.M., and M.D.) in dependently evaluated participants’

responses for each case. Responses had been previously transcribed from the booklets to excel sheets so that evaluators were not aware of the experimental condition under which the diagnoses had been provided. Their evaluations corresponded for 89% of the diagnoses; discrepancies were resolved by discussion. For each participant, the scores obtained on the four cases of cardiovascular diseases were averaged. An ANOVA (significance level: 0.05) with experimental condition (self- explanation versus hypothetico-deduction condition) as be- tween-subjects factor was conducted. This analysis tested the hypothesis that self-explanation while solving clinical cases would foster learning and would lead to better diagnostic performance on the test.

Results

Fifty-nine (out of 188) students declined and 41 students either failed to complete all the phases or provided insufficient data to be included. Eventually, 49 female and 39 male students (mean age 22.1 years, standard deviation 1.98) participated in the study.

Table 5.3 contains the descriptive statistics of the experiment. A univariate analysis of variance was conducted with experimental condition as independent variable and diagnostic accuracy as the dependent variable. Students in the hypothetico-deduction condition performed better than those in the self-explanation condition, $F(1, 86)=4.20$, $p=0.04$. The effect size was small (Cohen's $d=0.38$).[18]

No differences in performance were observed on the filler cases, $F(1, 86)=0.91$, $p=0.76$, Cohen's $d=0.05$, suggesting that the groups were indeed similar and randomization was successful.

Table 5.3 Means and standard deviations of diagnostic accuracy scores under the conditions of the experiment (self-explanation versus hypothetico-deduction) for male and female participants.

Experimental condition	Mean	Standard deviation	*N*
Hypothetico-deduction	0.22	0.14	45
Self-explanation	0.17	0.12	43
Total	0.20	0.13	88

Discussion

The purpose of the present experiment was to study the effectiveness of self-explanation of clinical cases in small tutorial groups relative to a hypothetico-deductive approach. Our hypothesis was that the self-explanation approach would yield higher gains because it enables students to activate previously acquired pathophysiological knowledge that would create coherence among the signs and symptoms to be explained and therefore facilitate

subsequent diagnosis of similar cases.[15,19] To study this hypothesis, we required students to work in small groups on seven cases to either provide a suitable pathophysiological explanation for each of them, in addition to providing a diagnosis, or to hypothesize about signs and symptoms presented sequentially. One week later, all students received the same eight cases and were required to provide a diagnosis.

Contrary to expectation, the students who were asked to engage in hypothetico-deduction, a task very similar to the task of the physician, performed significantly better than the self-explanation group. The effect was small, but it should be realized that it emerged even though the two approaches were employed in a single session and a small number of cases. In real educational programs, the approaches would be repeatedly employed throughout a series of sessions and cases, with a potentially higher effect. This is somewhat surprising because self-explanation, and other interventions that aim at elaboration or strengthening a person's knowledge base, are usually successful in doing so. Since arriving at a correct diagnosis is a knowledge-based activity, self- explanation should be expected to be helpful. This finding also seems to contradict previous findings by Chamberland and colleagues.[15] They found self-explanation to be the superior approach when measuring performance on a set of new cases at a later point in time. However, their learning phase entailed the interaction between a single student, rather than a group of students, and a facilitator. In addition, their control condition was not asked to process the cases sequentially, but to provide a best diagnosis based on the engagement with a whole case.

A number of possible explanations for these divergent findings present themselves. First, some facilitators reported that students in the self- explanation groups had difficulty coming up with explanations incorporating mechanisms or principles underlying the signs and symptoms in the cases. It seemed that they had already forgotten much of the basic science they learned previously or had difficulty applying pathophysiology to actual clinical cases. This may be a reason that the self-ex- planation condition did not reach its full potential: it simply insufficiently activated relevant knowledge to strengthen the students' knowledge base.

Second, the hypothetico-deductive condition encouraged students to explicitly consider more than one hypothesis, while the self-explanation condition did not. Since the cases in the learning phase and the test phase were not identical, the chances are that those who were hypothesizing about possible diagnoses also considered one of more diagnoses that returned in the test phase, giving them a slight edge over the self-explanation group. On the other hand, in the studies by Chamberland and colleagues.[15] and those of Mamede and colleagues,[20,21] the knowledge elicitation procedures excelled in particular with transfer cases, that is: cases that were in the same domain (for instance: cardio- vascular disease) but had different diagnoses. To be fair, it has to be noted, however, that their studies did not include a comparison with a hypothetico-deduction condition.

A third factor possibly favouring the hypothetico-deduction condition is that our experimental setup forced us to provide both groups with the same patient information, even if students in the hypothetico-deduction condition *did not ask for that information*. In real life, as in most educational settings, hypothetico-deduction is driven by the informational needs as seen by the doctor or student engaged in diagnosing a case. The problem-solver receives only the information he or she has asked for. Nendaz has demonstrated that, when doctors and students diagnose clinical vignettes using the hypothetico-deductive approach, they perform less well than groups who receive the whole case.[12] Our hypothetico-deduction condition may have profited from receiving all the information, even the information it did not ask for.

A fourth issue limiting our study is the surprisingly low performance of all our groups. With mean scores around 0.20 on a scale between 0 and 1, our participants' achievements were well under the achievements of students in similar studies.[20,21] Again, this may indicate that our participants simply did not yet have sufficient knowledge to deal with the cases, and therefore those who produced, perhaps haphazardly, more different hypotheses during the learning phase, had a slight edge over those who did not. More research is clearly necessary here.

It should be highlighted that many of these limitations can be seen as a side effect of our attempt at increasing ecological validity. We opted for comparing the two approaches under conditions that would closely simulate those encountered in an actual medical program: students worked in small groups with different facilitators. In doing so, we may have gained in validity, but strict control over the discussion in the groups was not possible. This comes as the unavoidable trade-off between ecological validity and experimental control.

In conclusion, the much-used hypothetico-deductive method for teaching clinical reasoning did relatively well in our study. Tentative explanations have been raised but further research is required to explore which approach works better and under which conditions. New methods, such as self-explanation, need further scrutiny.

References

1. ALQahtani DA, Rotgans JI, al Mamede Set. Does Time Pres- sure Have a Negative Effect on Diagnostic Accuracy? Acad Med. 2016;91:710–6.
2. Schmidt HG, Mamede S, Schuit SCE, et al. Do patients' disruptive behaviours influence a doctor's diagnostic accuracy? A randomized experiment. BMJ Qual Saf. 2017;26:19–23.
3. Croskerry P. From Mindless to Mindful Practice — Cognitive Bias and Clinical Decision Making. N Engl J Med. 2013;368:2445–8.
4. Schmidt HG, Mamede S. How to improve the teaching of clin- ical reasoning: a narrative review and a proposal. Med Educ. 2015;49:961–73.
5. White KL, Williams TF, Greenberg BG. The ecology of medical care. N Engl J Med. 1961;265:885–92.
6. Peabody JW, Luck J, Glassman P, Dresselhaus TR, Lee M. Com- parison of vignettes, standardized patients, and chart abstraction: a prospective validation study of 3. Methods Meas Qual Jama. 2000;283:1715–22.
7. Peabody JW, Luck J, Glassman P, et al. Measuring the quality of physician practice by using clinical vignettes: a prospective valida- tion study. Ann Intern Med. 2004;141:771–80.
8. Elstein AS, Shulman LS, Sprafka SA. Medical problem solving: An analysis of clinical reasoning. Cambridge, MA: Harvard University Press; 1978.
9. Dequeker J, Jaspaert R. Teaching problem-solving and clinical reasoning: 20 years experience with video-supported small-group learning. Med Educ. 1998;32:384–9.
10. Fuks A, Boudreau JD, Cassell EJ. Teaching clinical thinking to first-year medical students. Med Teach. 2009;31:105–11.
11. Kassirer JP. Teaching Clinical Reasoning: Case-Based and Coached. Acad Med. 2010;85:1118–24.
12. Nendaz MR, Raetzo MA, Junod AF, Vu NV. Teaching Diagnos- tic Skills: Clinical Vignettes or Chief Complaints? Adv Health Sci Educ Theory Pract. 2000;5:3–10.
13. Chi MTH, Deleeuw N, Chiu MH, Lavancher C. Eliciting self-ex- planations improves understanding. Cogn Sci. 1994;18:439–77.
14. Chamberland M, Mamede S, St-Onge C, et al. Students' self-ex- planations while solving unfamiliar cases: the role of biomedical knowledge. Med Educ. 2013;47:1109–16.
15. Chamberland M, St-Onge C, Setrakian J, et al. The influence of medical students' self-explanations on diagnostic performance. Med Educ. 2011;45:688–95.
16. Woods NN. Science is fundamental: the role of biomedical knowl- edge in clinical reasoning. Med Educ. 2007;41:1173–7.
17. Springer L, Stanne ME, Donovan SS. Effects of small-group learn- ing on undergraduates in science, mathematics, engineering, and technology: A meta-analysis. Rev Educ Res. 1999;69:21–51.
18. Cohen J. A power primer. Psychol Bull. 1992;112:155–9.
19. Chamberland M, Mamede S, St-Onge C, Setrakian J, Schmidt HG. Does medical students' diagnostic performance improve by observ- ing examples of self-explanation provided by peers or experts? Adv Health Sci Educ Theory Pract. 2015;20:981–93.
20. M[illegible], van Gog T, Moura AS, et al. Reflection as a strategy to foster medical students' acquisition of competence. Med Educ. 2012;46:464–72.
21. [illegible], van Gog T, Sampaio AM, de Faria RMD, Maria JP, Schmidt HG. How Can Students' Diagnostic ce Benefit Most From Practice With Clinical Cases? The Effects of Structured Reflection on Future Diagnosis of the Same and Novel Diseases. Acad Med. 2014;89:121–7

Chapter 6

Teaching Clinical Reasoning: An Experiment Comparing the Effects of Small-group Hypothetico-deduction Versus Self-explanation

This chapter was submitted to the BMC Journal of Medical Education:
Al Rumayyan A, Mamede S, Magzoub ME, Schmidt HG, van Mook WNKA, Ahmed N. Teaching Clinical Reasoning: An Experiment Comparing the Effects of Small-group Hypothetico-deduction Versus Self-Explanation

Abstract

Background: Approaches for the teaching of clinical reasoning have been extensively discussed, but research on their effectiveness is scarce. A recent study showed hypothetico-deduction to be slightly more beneficial than self-explanation for students' diagnostic performance, but an account for this difference was unclear. The present study investigated whether hypothetico-deduction leads to consideration of more alternative diagnoses while practicing with clinical cases, and whether its advantage over self-explanation would be replicated when diseases slightly different from the ones previously studied are tested.

Methods: One-hundred thirty-nine 2nd-year students from a six-year medical school participated in a two-phase experiment. In the learning phase, they worked in small groups on five clinical vignettes representing cardiovascular diseases. The participants followed different approaches to work on each vignette depending on the experimental condition to which they had been assigned. Students under the self-explanation condition provided the most likely diagnosis and a pathophysiological explanation for the clinical findings while under the hypothetico-deduction condition students hypothesized about plausible diagnoses for clinical findings that were presented sequentially. In a one-week-later test, all students diagnosed eight cases of cardiovascular diseases with clinical presentations similar to the ones studied in the learning phase but different diagnoses. Univariate analyses of variance were conducted with experimental condition as independent variable and the mean number of diagnoses considered in the learning phase and mean diagnostic accuracy score (range 0-1) in the test as independent variables.

Results: Students under the hypothetico-deduction condition generated more alternative diagnoses in the learning phase than those under the self-explanation condition, $F(1, 177)=199.51$, $p=.001$, $\eta^2=.53$; the effect size was large. A small difference in favour of hypothetico-deduction was observed in the proportion of accurate diagnoses: $F(1, 138)=4.08$, $p=.05$, $\eta^2=.03$.

Conclusions. Relative to self-explanation, hypothetico-deduction induced consideration of more alternative diagnoses during practice with cases. This may explain the slight benefit of hypothetico-deduction over self-explanation regarding students' diagnostic performance.

Introduction

The ability to make sound clinical judgments is a core component of physicians' competence, and the development of students' clinical reasoning is a medical teachers' major goal in the curricula of most medical schools.[1] This widespread acknowledgment of the importance of teaching clinical reasoning does not come together with an agreement on how this should be done. Approaches for the teaching of clinical reasoning have been much discussed, but the little empirical evidence available on what works better and for whom provides teachers with little guidance for the choices they are to make.[2,3]

In recent years, teachers have particularly been confronted with the challenge of choosing the optimal instructional approach to be employed in students' practice with simulated clinical cases. This challenge emerged because many schools now offer, sometimes since the early years of training, clinical reasoning courses which involve primarily practicing the diagnosis and/or management of simulated clinical cases. These courses appear to be a response to the recognition that the traditional locus for students to learn clinical reasoning – the clinical clerkships – has substantial drawbacks, such as the difficulty to ensure exposure to a large variety of clinical problems and appropriate supervision.[4,5] In clinical reasoning courses, simulated cases are employed to provide students with the opportunity to practice with a large spectrum of clinical conditions while receiving appropriate supervision and feedback. However, although practice with clinical cases is a common characteristic of these courses, there is a large variation in the instructional approach adopted, as shown by a recent review of the literature.[6] As these approaches have rarely been empirically investigated, little is known about their effectiveness.

The present study is concerned with two approaches that have been used for the teaching of clinical reasoning: 'hypothetico-deduction' and self-explanation.[6] Hypothetico-deduction resembles physicians' diagnostic process in actual clinical practice. Information about the patient problem is provided to students in a sequential fashion. Little information is initially available, and as the student engages with the case, generates diagnostic hypotheses and requires information to verify the potential consequences of these hypotheses, after which additional information is provided. Conversely, for self-explanation the complete case information is presented from the start, and students are required to generate a diagnosis and explain the underlying mechanisms of the patient's symptoms. Self-explanation is based on the assumption that reactivating previously learned knowledge and constructing the pathophysiological explanation would lead students to more clearly bringing together the signs and symptoms of the diseases, facilitating the diagnosis of new cases of the same diseases in the future.[7,8]

Despite appearing to be the most prevalent approach used in clinical teaching,[5] hypothetico-deduction was until recently not supported by any empirical evidence. Self-explanation, on the other hand, has been shown to increase medical students' diagnostic competence in several experimental studies.[8-10] In these experiments, cases were always

presented to students individually, a condition that deviates from what is expected to happen in an actual medical curriculum, where students usually practice with peers. A recent experimental study by our group compared the effects of hypothetico-deduction and self-explanation in small groups.[11] In a learning phase, second-year medical students, working in small groups, diagnosed a set of clinical cases either by using hypothetico-deduction or self-explanation. One week later, a test was administered that required students to diagnose a set of cases consisting of new exemplars of the clinical presentations studied in the learning phase. Diagnostic accuracy was measured. Students who engaged in hypothetico-deduction in the learning phase performed (slightly but significantly) better than the self-explanation group, a finding contradictory to our expectations.

Because self-explanation aims at restructuring and strengthening a learner's knowledge base, it can be expected to be beneficial for performance in a knowledge-based activity such as the diagnostic task. Indeed, this assumption has proved correct in several studies in which not only self-explanation[8,9] but also other strategies based on knowledge reconstruction[12] improved students' diagnostic performance. What could then explain the positive effect of hypothetico-deduction relative to self-explanation? We could not satisfactorily answer this question with the measurements available in our previous study. A tentative explanation may be that, different from self-explanation, hypothetico-deduction encouraged students to explicitly consider more than one diagnosis while working through the case. Because the cases solved in the learning and the test phase were not identical, students who hypothesized about several alternative diagnoses in the learning phase possibly also considered one or more diagnoses that returned in the test phase.

The present study examined this hypothesis. A design similar to the previous one was employed, but we now studied the contents of the learning phase to investigate whether hypothetico-deduction leads to consideration of more alternative diagnoses than self-explanation. In addition, we investigated whether our original findings could be replicated but focused on transfer by testing performance not on cases similar to the ones studied in the learning phase but on slightly different diseases.

Methods

Design of the study

The study consisted of two phases: a learning phase and a delayed diagnostic performance test administered 1 week later.

In the learning phase, participants in small groups of approximately six discussed and diagnosed five cardiovascular clinical cases under two different experimental conditions. Students were randomly assigned to the conditions of the experiment. Students in the

hypothetico-deduction condition were presented with case information in a sequential fashion, had to provide tentative hypotheses, test these hypotheses as more information became available, and discuss their findings in small groups. The students in the *self-explanation* condition were presented with the whole case and were asked to explain the signs and symptoms in terms of their underlying pathophysiology in small groups and provide a diagnosis as well.
In the second phase, the test required candidates to diagnose a set of eight new clinical cases, representing diseases within the same (cardiovascular) system, but with different diagnoses.

Participants

All 188 male second-year medical students at King Saud bin Abdulaziz University medical college, in Riyadh, Saudi Arabia, a six-year medical school, were invited to participate in this study conducted in September 2016. We recruited Year 2 students because, at this point in their training, they have been exposed to theoretical knowledge with regard to cardiology, but not yet encountered any patients. Written consent was obtained from all students involved. They were promised that data would be analyzed anonymously. One-hundred seventy-eight students complied.
Ethical approval for the study was given by King Abdullah International Medical Research Center (KAIMRC) Riyadh, Kingdom of Saudi Arabia.

Materials

Two sets of different clinical cases were used in the study, one for each phase (See Table 6.1 for the diagnoses involved). Each case consisted of a half-page description of a patient's medical history, present complaints, findings of a physical examination and results of laboratory tests. See Table 6.2 for an example of such a case. The cases were based on real patients.[8] All came from the cardiovascular domain, as students had completed a cardiovascular system course three months before this study. In the learning phase, students used a response booklet in which they made notes.

Table 5.1 Diagnoses of the cases used in the different phases of the study

Learning phase		**Test phase**	
Case 1.1 -	Heart failure due to cor pulmonale	Case 2.1 -	ST elevation myocardial infarction (STEMI)
Case 1.2 -	Hypertension: secondary to coarctation of aorta	Case 2.2 -	Unstable angina
Case 1.3 -	Non-ST elevation myocardial infarction (NSTEMI)re	Case 2.3 -	Stable angina
Case 1.4 -	Vasovagal syncope	Case 2.4 -	Congestive heart failure (CHF) due to rheumatic mitral regurgitation
Case 1.5 -	Non-cardiac chest pain due to costochondritis	Case 2.5 -	Syncope due to complete heart block (CHB)
Case 1.6 -	Acute viral hepatitis (Filler)	Case 2.6 -	Pre-syncope due to ventricular

			tachycardia (VT)
Case 1.7 -	Alcoholic cardiomyopathy	Case 2.7 -	Resistant hypertension due to renal artery stenosis
		Case 2.8 -	Essential hypertension (HTN) with atrial fibrillation (AF)

Table 6.2 Example case (Heart failure due to cor pulmonale).

History This is a 63-year old male who was admitted to the medical ward with lower limb swelling and abdominal distention that were not responding anymore to his usual medications. About 3 years ago he complained to his doctor about marked weight gain, abdominal distention and puffy feet, which all improved dramatically with medications which included "urine tablets". Previously he observed that leg swelling recurs shortly after missing the "urine tablets" for few days. Over the last few weeks the swelling has become troublesome and seems not responding to treatment despite doubling the doses. Patient gave a long history of chronic cough and wheezing that used to be treated with inhalers. Recently he was prescribed home oxygen and home nebulizers. Patient has been a heavy smoker since the age of 15 years. He quit smoking just few months ago, when his respiratory condition became worse. Physical examination Patient is in a semi-setting position, having a puffy face and shallow breathing. He is using the accessory muscles during breaths and can hardly complete a sentence without catching a breath. He is connected to an oxygen source via a face mask. O_2 saturation is 91%, BP is 119/62 mmHg, pulse is 112 (regular). Peripheries are warm and cyanosed with marked pitting edema in the legs. Both "a" and "v" waves of the JVP are visible and seen at the level of earlobe. Heart sounds are muffled with no audible murmurs. Chest percussion is hyper-resonant and lung auscultation revealed reduced air entry bilaterally with scattered rhonchi. Investigations Renal function: BUN: 9.5 mmol/l (normal range: 3.5-7.2) and creatinine: 123 umol/l (normal range: 60-110). CBC: Hb: 21 gm/dl (normal range:14-17), Htc: 0.49 (normal range:0.42-0.52). ABG: pH: 7.33 (normal range: 7.35-7.45), PCO_2: 56 mmHg (normal range: 35-45), PO_2: 64 mmHg (normal range:80-100), HCO_3: 35 mEq/l (normal range:22-26). CXR: normal heart size, clear lung fields, flat diaphragms, no effusions

Procedure

Learning phase

The learning phase required the students to diagnose five clinical cases. The cases were presented through PowerPoint slides in one of two randomized orders. Participants were randomly assigned to either the self-explanation condition or the hypothetico-deduction condition by using the list of students enrolled in the second year of the program. Subsequently, they were randomly subdivided in groups of six, each with a facilitator who was a member of the academic staff. Prior to the study, the facilitators attended a two-hour training session aimed at familiarising them with the study and ensuring uniformity of the procedure. The facilitator's task was to take care that the procedure as described below was followed meticulously. He or she did not provide feedback or otherwise interfered with the learning. Each student was also presented with a response booklet with blank pages on which he or she was asked to make notes.

In the self-explanation condition, once the case was presented, the students were given the following instructions: 1. Please read the case quickly. 2. Write down one or more

diagnoses that come to mind. 3. Write down in bullet points which pathophysiological process may have caused the signs and symptoms in this case. 4. Now discuss your ideas about the pathophysiology of the case with you colleagues. 5. What is your final diagnosis? The first three steps were taken individually. On step 4. students had to explain to each other how the signs and symptoms in the case were produced by the underlying pathophysiology. On step 5. they were to agree on a most likely diagnosis. After having reached an agreement, the next case was presented on screen. Students did not receive feedback. The steps taken individually required written responses, whereas the other steps; demanded only verbal reporting.

In the hypothetico-deduction condition, each case was presented in sequential fashion: history, physical examination, and laboratory test results would appear only after students followed the relevant parts of the instructions: (for the history part) 1. Write down one or more diagnoses that come to mind while reading the history. 2. What further information would you need to test these diagnostic hypotheses? 3. Now discuss your ideas with you colleagues (for the physical examination part) 4. Write down here one or more diagnoses that come to mind while reading the physical examination information. 5. What further information would you need to test these diagnostic hypotheses? 6. Now discuss your ideas with you colleagues (for the laboratory tests part) 7. Write down one or more diagnoses that come to mind while reading the laboratory data. 8. What is your final diagnosis? 9. Now discuss this conclusion with your colleagues. Steps 3, 6, and 9 required students to discuss ideas with their colleagues; the other steps were taken individually. As in the self-explanation condition, the steps taken individually required written responses, whereas the other steps demanded only verbal reporting. After completing a case, the next case was presented sequentially. Students were allowed to take as much time as they needed, but experimenters were instructed to spend no more than ten minutes on each case and to record the total time needed to finalize the learning task. No significant differences in time emerged.

Test phase

One week after the training phase, the students received, under examination conditions, a booklet with eight cases. Students were requested to read each case and write down the most likely diagnosis. At the end of the test phase, students were debriefed with regard to the purpose of the experiment.

Data analysis

The diagnoses provided in the learning phase were collated for each of the students, and the number of diagnoses, including or excluding repetitions, were counted.

The diagnosis provided by the participants to each case in the test phase was evaluated as correct, partially correct or incorrect, receiving scores of 1, 0.5, or 0 respectively. The

diagnosis was considered correct whenever the core correct diagnosis of the case was provided (e.g., 'stable angina'). When the core diagnosis was not given; but one component of the diagnosis was mentioned, the diagnosis was considered partially correct (e.g., 'syncope' rather than 'syncope due to complete heart block"). When the participant's response did not fall into one of these categories, the diagnosis was considered incorrect. Two experts in internal medicine independently evaluated 20 participants' responses for each case. Responses had been previously transcribed from the booklets to excel sheets so that evaluators were not aware of the experimental condition under which the diagnoses had been provided. Their evaluations corresponded for 92% of the diagnoses; the remaining records were assessed by one of the experts.

For each participant, the total number of diagnoses mentioned in the response booklet, and the total number of diagnoses without repetitions, were counted. An ANOVA (significance level: 0.05) with experimental condition (self-explanation versus hypothetico-deduction condition) as between-subjects factor was conducted. The hypothesis tested was that students in the hypothetico-deduction condition would be producing significantly more diagnoses because their exercise was specifically aimed at the production of diagnoses.

Scores obtained in the test on the eight cases of cardiovascular diseases were averaged. An ANOVA (significance level: 0.05) with experimental condition (self-explanation versus hypothetico-deduction condition) as between-subjects factor was conducted. This analysis tested the hypothesis that hypothetico-deduction while solving clinical cases would lead to better diagnostic performance on the test.

Results

Table 6.3 presents the descriptive statistics of the number of diagnoses mentioned in the response booklet during the learning phase, with and without repetitions.

Table 6.3 Mean number of diagnostic hypotheses per case during the learning phase with and without repetitions.

	Treatment	N	Mean	Standard Deviation
Mean number of diagnostic hypotheses mentioned per case including repetitions	Hypothetico-deduction	78	5.42	1.52
	Self-explanation	100	2.95	0.75
	Total	178	4.03	1.69
Mean number of diagnostic hypotheses mentioned per case without repetitions	Hypothetico-deduction	78	3.72	1.08
	Self-explanation	100	2.31	0.70
	Total	178	2.93	1.12

Due to an administrative error, more students ended up in the self-explanation condition. Random removal of 22 students did not affect the results and therefore the full dataset was analyzed. Univariate analyses of variance were conducted on the data displayed in Table

6.3 with experimental condition as independent variable and diagnosis count as the dependent variable. For mean number of diagnostic hypotheses mentioned, including repetitions: $F(1, 177)=199.51$, $p=.001$, effect size eta squared equal to .53. For mean number of diagnostic hypotheses mentioned, without repetitions: $F(1, 177)=109.57$, $p=.001$, effect size eta squared equal to .38. Both eta squared values can be interpreted as the portion of variance explained by the treatment. Both can be considered sizable.

Table 6.4 displays the descriptive statistics of the proportion of accurate diagnoses produced at test.

Table 6.4 Mean proportion of accurate diagnoses produced at test for both experiment.

Treatment	N	Mean	Standard Deviation
Hypothetico- deduction	67	.39	.18
Self-explanation	72	.33	.16
Total	139	.36	.17

Thirty-nine students who participated in the learning phase failed to show up for the test one week later; a dropout rate of 22%. Reasons were illness, having another appointment, or just forgotten. Using GPA-scores, we checked whether these absent students were in any way different from those present. No significant differences between both groups were found. Univariate analyses of variance were conducted on the data displayed in Table 4 with experimental condition as independent variable and diagnostic accuracy as the dependent variable. For the proportion of accurate diagnostic hypotheses: $F(1, 138)=4.08$, $p=.05$, effect size eta squared equal to .03. These findings represent a significant but small difference in diagnostic accuracy favouring students under the hypothetico-deduction condition.

Discussion

The purpose of the present study was twofold. First, we investigated whether hypothetico-deduction during practice with clinical cases leads to consideration of a higher number of possible diagnoses relative to self-explanation. This was a tentative explanation for the finding from a previous experiment showing hypothetico-deduction to foster students' diagnostic performance relative to self-explanation. Second, we studied whether this higher effectiveness of hypothetico-deduction over self-explanation in fostering diagnostic performance could be replicated for diseases slightly different (though in the same domain) from the ones studied in the learning phase. The results of our study of the contents of the learning phase support our tentative explanation. Students who engaged in hypothetico-deduction considered more diagnoses than the students from the self-explanation condition. Furthermore, relative to self-explanation hypothetico-deduction led to a slightly better diagnostic accuracy in the test which consisted of cases whose clinical presentation was similar to the ones studied in the learning phase but had different diagnoses.

A close look at the instructions provided to the two conditions can explain the findings referring to the number of diagnoses considered in the learning phase. Hypothetico-deduction required students to generate alternative diagnoses in three different moments: after disclosure of information on the patient's history, on physical examination and on diagnostic tests. This operationalization of hypothetico-deduction comes close to the format that has been employed in the teaching of clinical reasoning.[6,13] On the other hand, self-explanation, consistently with its use in research on learning in other domains and in medicine,[14] required students to generate alternative diagnoses only at the start.

Subsequently, they engaged in explaining the pathophysiological mechanisms underlying the patient's signs and symptoms without being encouraged to re-consider their initial hypotheses. It is not surprising therefore those students from the hypothetico-deduction condition raised more diagnoses than those from the self-explanation condition. The difference was substantial, particularly when repeated diagnoses were included.

This difference may have contributed to the slightly better performance of the hypothetico-deduction condition relative to the self-explanation condition in the test. This is so because generating a diagnosis and weighing the evidence supporting it in the learning phase would possibly strengthen the student's knowledge of this disease. For example, while working through the case of myocardial infarction in the learning phase, the student may have considered the diagnosis of unstable angina. Repeatedly weighing the extent to which the findings encountered in each of the three moments supported the tentative diagnosis of unstable angina may have contributed to strengthening knowledge of the disease represented in the student's memory. This would probably make the student who raised and analysed the diagnosis of unstable angina slightly more apt to recognize the case of this disease in the test than a student who did not think about it in the learning phase. The more diagnoses were examined in the learning phase, the higher the chance of having thought about one (or more) of the diagnoses that would be encountered in the test one week later. By inducing consideration of a larger number of diagnoses, hypothetico-deduction therefore placed students in a slight advantage relative to the self-explanation group.

The superiority of hypothetico-deduction over self-explanation seems to contradict previous studies showing self-explanation in a learning phase to improve diagnostic performance in a later test.[8,14,15] It should be noticed, however, that the control group in these studies followed instructions very different from the hypothetico-deduction condition. The control group was not requested to think about different alternative diagnoses and match them with the case features but was requested only to give the best diagnosis for the case. This certainly entails much less elaboration and reconstruction of students' knowledge base than what may be expected to happen in hypothetico-deduction.

Our findings can be seen as diverging also from previous research showing the benefits of studying the causal mechanisms of diseases over studying associations between particular symptoms and these diseases.[16,17] Students who studied the causal mechanisms showed higher diagnostic performance in a test administered one week later in these studies. These results are seen as demonstrating the value of biomedical knowledge, which helps link specific clinical features together, setting meaningful relationships between them. With increased time lag between learning and test, students would rely more on these coherent relationships between features to make diagnoses than on consideration of isolated features.[16,17] The poorer performance of the self-explanation group in our experiment speaks against this conclusion from these studies. A methodological difference that might be taken into account is the material used in the learning phase. Whereas students in our

experiment worked with clinical cases, the learning material in the aforementioned studies consisted of tables displaying the diseases and the probability that each feature is present. It cannot be excluded that clinical cases provided a more vivid, consequently more easily retained, picture of a disease. It can also be however, that the difference in favour of the hypothetico-deduction in our study, which was very small, would not survive the test of time and would vanish subsequently. By now, these are only conjectures that require further investigation.

A limitation of the present study emerges from the option to investigate the effect of the approaches when students worked in small groups with different facilitators. This choice approximates the condition under which students worked in the experiment to those that would be encountered in an actual clinical reasoning course but opens the door for the contents of the group discussion to influence the results. When students are tested individually, as it happened in previous research on self-explanation with medical students, much more control over exchange of information during the case work out is possible. Another issue possibly limiting the study is the students' low performance in the test. The diagnostic accuracy scores are substantially lower than the ones observed in the aforementioned research.[8,17]

It can be questioned whether students in the self-explanation condition were actually able to activate sufficient biomedical knowledge to construct coherent pathophysiological explanations. Furthermore, it may well be that students who possess more prior knowledge of the diseases would benefit less from the elaboration that hypothetico-deduction induces, which may be low.

In summary, the present study showed hypothetico-deduction to induce consideration of a larger number of alternative diagnoses during practice with clinical cases relative to self-explanation. This may explain the slight benefit of hypothetico-deduction over self-explanation to students' diagnostic performance, which was replicated in this study for the diagnosis of diseases slightly different from the ones previously studied. Whether more knowledgeable students would benefit from hypothetico-deduction and whether its small advantage over self-explanation would vanish over time require further investigation.

References

1. Norman G. Research in clinical reasoning: past history and current trends. Med Educ. 2005;39(4):418-27.
2. Kassirer JP. Teaching clinical reasoning: case-based and coached. Acad Med. 2010;85(7):1118-24.
3. Eva KW. What every teacher needs to know about clinical reasoning. Med Educ. 2005;39(1):98-106.
4. Wimmers PF SH, Splinter TA. Influence of clerkship experiences on clinical competence. Med Educ. 2006;40(5):450-8.
5. Rattner SL, Louis DZ, Rabinowitz C, Gottlieb JE, Nasca TJ, Markham FW, et al. Documenting and comparing medical students' clinical experiences. JAMA. 2001;286(9):1035-40.
6. Schmidt HG, Mamede S. How to improve the teaching of clinical reasoning: a narrative review and a proposal. Med Educ. 2015;49(10):961-73.
7. Chamberland M, Mamede S, St-Onge C, Rivard MA, Setrakian J, Levesque A, et al. Students' self-explanations while solving unfamiliar cases: the role of biomedical knowledge. Med Educ. 2013;47(11):1109-16.
8. Chamberland M, St-Onge C, Setrakian J, Lanthier L, Bergeron L, Bourget A, et al. The influence of medical students' self-explanations on diagnostic performance. Med Educ. 2011;45(7):688-95.
9. Chamberland M S-OC, Setrakian J, Schmidt HG. Does medical students' diagnostic performance improve by observing examples of self-explanation provided by peers or experts? Ad Health Sci Educ Theory Pract. 2014.
10. Larsen D, Butler, AC, Roediger, H. Comparative effects of test-enhanced learning and self-explanation on long-term retention. Med Educ. 2013;47(7):674-82.
11. Al Rumayyan A, Ahmed N, Al Subait R, Al Ghamdi G, Mohammed Mahzari M, Awad Mohamed T, et al. Teaching clinical reasoning through hypothetico-deduction is (slightly) better than self-explanation in tutorial groups: An experimental study. Perspect Med Educ. 2018;7(2):93-9.
12. Mamede S, van Gog T, Moura AS, de Faria RM, Peixoto JM, Rikers RM, et al. Reflection as a strategy to foster medical students' acquisition of diagnostic competence. Med Educ. 2012;46(5):464-72.
13. Linsen A, Elshout, G, Pols, D, Zwaan, L, Mamede. S. Education in Clinical Reasoning: An Experimental Study on Strategies to Foster Novice Medical Students' Engagement in Learning Activities. Health Professions Education. 2018;4(2):86-96.
14. Chamberland M, Mamede, S. Self-Explanation, An Instructional Strategy to Foster Clinical Reasoning in Medical Students. Health Professions Education. 2015;1(1):24-33.
15. Chamberland M, Mamede S, St-Onge C, Setrakian J, Bergeron L, Schmidt H. Self-explanation in learning clinical reasoning: the added value of examples and prompts. Med Educ. 2015;49(2):193-202.
16. Woods N, Brooks L,R, Norman, GR. It all make sense: biomedical knowledge, causal connections and memory in the novice diagnostician. Adv Health Sci Educ Theory Pract. 2007;12(4):417-26.
17. Woods NN, Brooks LR, Norman GR. The role of biomedical knowledge in diagnosis of difficult clinical cases. Adv Health Sci Educ Theory Pract. 2007;12(4):417-26.

Chapter 7

Summary and conclusions

Summary and conclusions

The two themes of this thesis professionalism and clinical reasoning, were investigated in five studies. In this Chapter the results of the studies in the previous Chapters are more generally discussed in perspective of the available scientific literature. Thereafter, the strengths of the studies are highlighted, and their limitations identified. This Chapter ends with suggestions for further research and implications for practice.

Professionalism was covered by the first two studies while the last three studies focused on clinical reasoning.

Professionalism

The first cross-sectional descriptive aimed to identify the perception of pediatric residents regarding medical professionalism within two healthcare tertiary settings in Riyadh, Saudi Arabia. Sixty-seven pediatric residents participated in this study and completed a questionnaire to assess their perception towards medical professionalism. The response rate was 64%. The majority of participants rated themselves very good to excellent on all elements of professionalism. No significant differences were found in all items of professionalism with regards to age groups ($p>0.05$). Females perceived professionalism significantly higher than male residents. In light of this study most pediatric residents favorably perceived the concept of medical professionalism and underlying principles. A further study with a larger sample size is warranted in the future.

The second study on narrative overview of medical professionalism in non-Western cultures revealed four major findings. First, only four studies attempted to develop a three culture-tailored non-Western framework for medical professionalism (Nishigori et al. 2014); Al-Eraky et al. (2014), Ho et al. (2011), and Pan et al. (2013) representing Japan, Arab world, and China, respectively. Pan et al. (2013) extended the framework of China originally developed by Ho and associates (Ho et al. 2011). These studies provided culture-specific elements in a unique conceptual framework of medical professionalism representing the region they originated from. Second, the three identified non-Western frameworks have commonalities of universally praised attributes, but they were interpreted differently in various cultures. For instance, integrity was relevant to *Zizhong* in Chinese Confucian values, while self-motivation and self-accountability were interpreted as *taqwa* and *ehtesab* in the Arabian context, respectively. The differences thus concern the interpretation and prioritization of the attributes. Medical professionalism is context-specific. There is no single framework on professionalism that can be globally acknowledged. A culture-oriented concept of professionalism is necessary to understand what the profession is dedicated to and to incorporate the concept into the medical students' and physicians' professional

identity formation. Finally, the authors propose an extended framework to include culture as background to attribute to leading to an outcome on health care.

The third study compared the academic performance and professionalism lapses of high school entry and graduate entry (GE) students who undertook the same curriculum and examinations in the College of Medicine, Riyadh, KSAU-HS. In this study, examination scores of 196 high school graduates and 54 GE students over a 4-year period (2010–2014) were used as a measure of academic achievement. For assessment of professionalism lapses, we compared the number of warning letters in both streams of students. Overall, both streams of students performed equally well with high school entry students performing better than GE students in a few pre-clinical courses. We also compared the incidence of professionalism lapses between the groups, and found an increase in number of warning letters for GE students. More studies are needed to evaluate potential differences in other assessments of professionalism between these two streams of students.

Clinical reasoning

The fourth study compared the effects of self-explanation in small groups with the more commonly used hypothetico-deductive approach on diagnostic performance. Second-year students from a six-year medical school worked in small groups on seven clinical vignettes. Students were randomly assigned to the two experimental condition. The much-used hypothetico-deductive method for teaching clinical reasoning did relatively well in this study. Tentative explanations have been raised but further research is required to explore which approach works better and under which conditions. New methods, such as self-explanation, need further scrutiny.

The fifth study investigated whether hypothetico-deduction leads to consideration of more alternative diagnoses while practicing with clinical cases, and whether its advantage over self-explanation would be replicated when diseases slightly different from the ones previously studied are tested. The participants for this study were 2nd-year students from a six-year medical school in Saudi Arabia.

This study showed hypothetico-deduction to induce consideration of a larger number of alternative diagnoses during practice with clinical cases relative to self-explanation. This may explain the slight benefit of hypothetico-deduction over self-explanation to students' diagnostic performance, which was replicated in this study for the diagnosis of diseases slightly different from the ones previously studied. Whether more knowledgeable students would benefit from hypothetico-deduction and whether its small advantage over self-explanation would vanish over time require further investigation.

Limitation of the studies

The limitations of these studies can be summarized in the following points:

Study one has a few caveats including a limited number of participating residents. However the tool appears to be internally consistent for resident's self-assessment of professionalism which can be reliably utilized. There is another expanded reliable and valid 36-item scale for assessing attitudes of medical students, residents, and faculty towards professionalism that was developed after taking into account all elements of professionalism as suggested by the American Board of Internal Medicine (ABIM) and use of this scale might have produced detailed results.

The ***second study's*** limitation is the utilization of narrative review methodology. This could not be circumvented however, since the number of studies was very limited and their endpoints different. So this was not deliberate *a priori* choice, but a consequence of the available limited publications. Nevertheless, it may affect the generalization of findings. However, the authors took all the measures to make it more objective by carefully following all the steps of conducting an effective narrative review.

The main limitation of ***study three*** is the small number of graduate entry program students (54) compared to high school entry students (196) which may limit the generalizability of results. In addition, only male students were included in the analysis as female students started later in the program. Finally, the assessment of professionalism is more complex than simply measured by the number of warning letters per student. Other professionalism measures are needed to compare professionalism between the two groups.
There are some limitations regarding study four. *First*, some facilitators reported that students in the self-explanation groups had difficulty coming up with explanations incorporating mechanisms or principles underlying the signs and symptoms in the cases. It seemed that they had already forgotten much of the basic science they learned previously or had difficulty applying pathophysiology to actual clinical cases. *Second*, the hypothetico-deductive condition encouraged students to explicitly consider more than one hypothesis, while the self-explanation condition did not. Since the cases in the learning phase and the test phase were not identical, the chances are that those who were hypothesizing about possible diagnoses also considered one of more diagnoses that returned in the test phase, giving them a slight edge over the self-explanation group. A *third* factor possibly favouring the hypothetico-deduction condition is that our experimental setup forced us to provide both groups with the same patient information, even if students in the hypothetico-deduction condition *did not ask for that information*. A *fourth* issue limiting our study is the surprisingly low performance of all our groups. With mean scores around 0.20 on a scale

between 0 and 1, our participants' achievements were well under the achievements of students in similar studies.

A limitation of study five emerges from the option to investigate the effect of the approaches when students worked in small groups with different facilitators. This choice approximates the condition under which students worked in the experiment to those that would be encountered in an actual clinical reasoning course but opens the door for the contents of the group discussion to influence the results. When students are tested individually, as it happened in previous research on self-explanation with medical students, much more control over exchange of information during the case work out is possible. Another issue possibly limiting the study is the students' low performance on the test. The diagnostic accuracy scores are substantially lower than the ones observed in the aforementioned research.(12,18) It can be questioned whether students in the self-explanation condition were actually able to activate sufficient biomedical knowledge to construct coherent pathophysiological explanations. Furthermore, it may well be that students who possesses more prior knowledge of the diseases would benefit less from the elaboration that hypothetico-deduction induces, which may be low.

Future research questions

Although our studies on professionalism and clinical reasoning reported in this thesis have provided useful scientific insight on these topics, future studies to add to these findings and circumvent the abovementioned limitations are needed. The following research questions could guide this future research.

1. The existing professionalism frameworks are based and focused on medical practice with less emphases on medical education. What are the impacts of professionalism on students' academic achievement, motivation and professional identity?
2. The existing professionalism frameworks are described only the attributes level without mentioning factors that influence these attributes such as the personal values, culture and role modelling. What are other contributing factors to professionalism beyond attributes?
3. The professionalism frameworks are not described in a causal model such as background, process and impact. Can professionalism be explained in a causal model including background, process, output and impact factors?
4. Describing only one attribute limits the immediate applicability in medical education to identify measurable learning outcome. What are the measurable learning outcomes of professionalisms in medical education?
5. The professionalism frameworks are mainly theoretical and not yet assess empirically using a reasonable set of data. Can a professionalism framework be tested empirically in medical education?
6. The future research questions for teaching clinical reasoning may include; What are the effects of other factors on clinical reasoning such as think aloud, concept mapping, mind mapping, peer education and reflections?

To rectify these limitations, we propose an extended three-level culture-sensitive and causal framework of professionalism which is more applicable to medical education to be implemented at the College of Medicine, King Saud bin Abdulaziz University for Health Sciences. (see Figure 7.1) This palm tree framework includes three levels starting with background factors "roots" which include three factors: culture, personal characteristics, institutional and environmental factors. The identification of these factors was based on research findings explained earlier. The second level includes the process factors which are the attributes based on other models (Stem). The third layer is the translational level of attributes into learning outcomes (Fruits) including professional identities, behaviors and academic achievements that can guide medical education. However, this extended three levels model needs to be further developed and tested empirically.

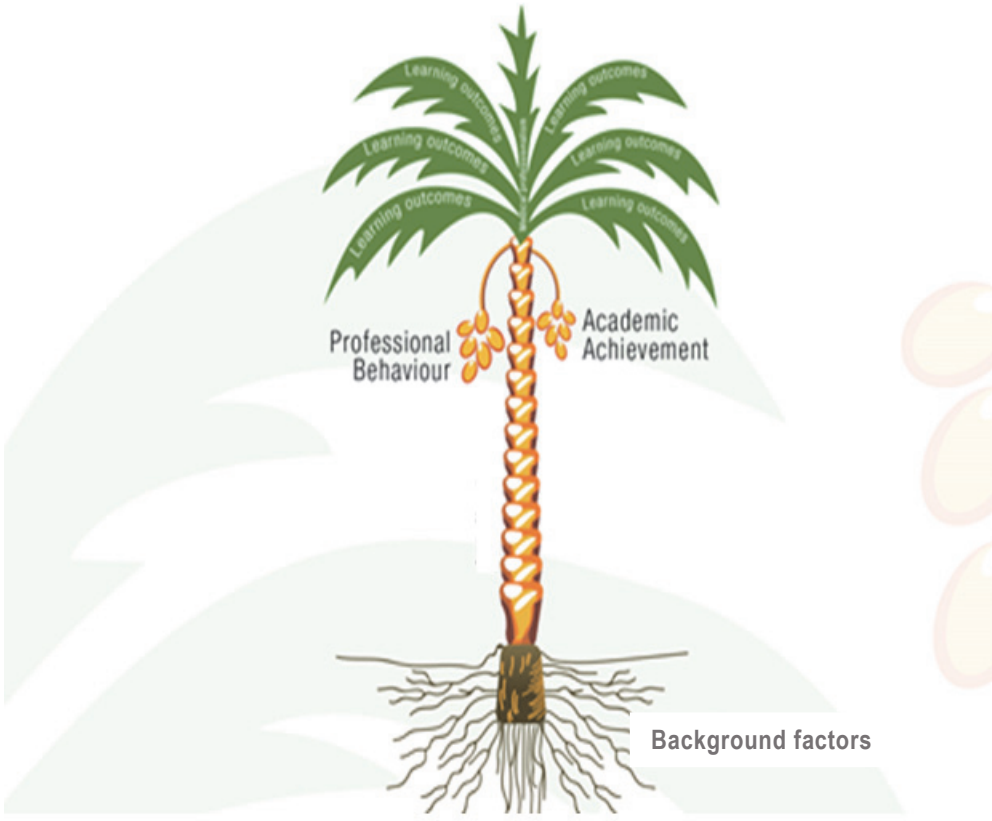

Figure 7.1 The **Palm Tree Professionalism** model

Summary and conclusions in Dutch

Samenvatting en conclusies

De twee thema's die centraal staan in dit proefschrift, professionaliteit en klinisch redeneren, werden onderzocht in vijf studies. In dit hoofdstuk worden de resultaten van deze individuele studies, beschreven in de vorige hoofdstukken, bediscussieerd in het perspectief van de huidige literatuur. Vervolgens worden de sterke punten van de studies benadrukt en de beperkingen benoemd. Dit hoofdstuk eindigt met aanbevelingen voor verder onderzoek en implicaties voor de praktijk.

Professionaliteit werd besproken in de eerste twee studies van deze thesis en in de laatste drie studies werd gefocust op het klinisch redeneren.

Professionaliteit

Het doel van de eerste cross-sectionele studie was het vaststellen van hoe kinderartsen in opleiding de medische professionaliteit waarnemen in twee medisch specialistische ziekenhuizen in Riyaad, Saudi-Arabië. Zeven-en-zestig kinderartsen in opleiding namen deel aan deze studie en vulden een vragenlijst in, gericht op hun waarneming van medische professionaliteit. De response was 64%. De meerderheid van de deelnemers beoordeelde zichzelf als zeer goed tot uitmuntend op alle vlakken van professionaliteit. Er werden geen significante verschillen gevonden tussen leeftijdsgroepen in de waarneming van professionaliteit ($p>0.05$). Vrouwen namen professionaliteit significant hoger waar dan mannelijke artsen in opleiding. De resultaten van deze studie lieten zien dat kinderartsen in opleiding het concept van medische professionaliteit en de onderliggende principes gunstig waarnamen. Een vervolgstudie met een groter aantal deelnemers is echter nodig.

Een beschrijvend overzicht (narrative review) in de tweede studie, over de medische professionaliteit in niet-Westerse culturen, beschreef vier hoofdbevindingen. Als eerste werden er maar vier studies gevonden in de literatuur die een poging hadden gedaan om een niet-Westers kader te ontwikkelen, afgestemd op drie culturen; respectievelijk Japan (Nishigori et al. 2014), de Arabisch wereld (Al-Eraky et al. 2014), en China (Ho et al. 2011, Pan et al. 2013). Pan et al. (2013) breidde het kader uit wat oorspronkelijk was ontwikkeld voor China door Ho en collega's (Ho et al. 2011). Deze studies gaven cultuurspecifieke elementen in een uniek conceptueel kader van de medische professionaliteit weer, welke representatief waren voor de regio waar ze waren uitgevoerd. Als tweede werd aangetoond dat de drie niet-Westerse kaders overeenkomsten vertoonden in eigenschappen die algemeen aanvaard zijn, maar deze eigenschappen werden verschillend geïnterpreteerd in de verschillende culturen. Integriteit was bijvoorbeeld relevant voor Zizhong in Chinees Confusische waarden, terwijl zelfmotivatie en zelfverantwoordelijkheid

respectievelijk als taqwa en ehtesab werden geïnterpreteerd in de Arabische context. De verschillen betreffen dus de interpretatie en prioritering van deze eigenschappen. Medische professionaliteit is context-specifiek. Er is geen één specifiek kader over professionaliteit wat wereldwijd kan worden toegepast. Een cultuur-georiënteerd concept van professionaliteit is nodig om te begrijpen waar het beroep zich aan wijdt alsmede het concept te integreren in professionele identiteitsformatie van medische studenten en clinici. Als laatste stellen de auteurs een uitgebreid kader voor, waarin culturen als achtergrond wordt gebruikt, om zodoende bij te dragen aan een betere uitkomstmaat voor gezondheidszorg.
In de derde studie werden de studieresultaten en professionele misstappen van twee groepen medische studenten met elkaar vergeleken; één groep studenten die direct na de middelbare school waren begonnen aan hun medische opleiding (afgestudeerden) en één groep studenten die al een andere bacheloropleiding hadden afgerond (bachelorstudenten). Deze twee groepen studenten volgden nu hetzelfde curriculum en legden dezelfde examens af in het College van Geneeskunde, Riyaad, KSAU-HS. Examenscores van 196 studenten die direct na hun middelbare school waren begonnen aan de opleiding en 54 studenten die al een andere bacheloropleiding hadden gevolgd werden verzameld over een periode van vier jaar (2010-2014) en gebruikt als een uitkomstmaat voor de academische prestaties. Het aantal professionele (medische) misstappen werden in kaart gebracht met het aantal waarschuwingsbrieven en dit aantal werd vergeleken tussen de twee groepen studenten. Over het algemeen presteerden beide groepen studenten even goed, waar de groep studenten die direct na de middelbare school was begonnen beter presteerden in een aantal preklinische cursussen. Het aantal professionele (medische) misstappen bleek toe te nemen voor de studenten die eerder een bacheloropleiding hadden afgerond. Meer studies zijn nodig om potentiële verschillen tussen de twee groepen studenten in professionaliteit te onderzoeken.

Klinisch redeneren

De vierde studie vergeleek de effecten van de zelf-uitleggende (self-explanation) benadering met de meer gebruikelijke hypothetisch-deductieve benadering op diagnostische prestatie. Tweedejaars studenten van een zesjarige medische opleiding werkten in kleine groepen aan zeven klinische scenario's. Deze studenten kregen één van de twee experimentele condities gerandomiseerd toegewezen (zelf-uitleggende versus hypothetisch-deductief). De meer gebruikelijke hypothetisch-deductieve benadering om klinisch redeneren te leren leverde relatief goede resultaten op. Voorlopige verklaringen werden gesuggereerd in de studie, echter is vervolgonderzoek nodig om te onderzoeken welke van de twee benaderingen een beter resultaat oplevert, en onder welke

omstandigheden. Nieuwe methodes, zoals de zelf-uitleggende benadering, behoeven nader onderzoek.
In de vijfde studie werd onderzocht of a) de hypothetisch-deductieve benadering leidt tot de overweging van meer alternatieve diagnoses tijdens het beoefenen van klinische casussen, en b) of de voordelen van de hypothetisch-deductieve methode ten opzichte van de zelf-uitleggende benadering zich ook zullen vertonen wanneer ziektes zich enigszins anders voordoen dan getest in eerdere studies. De deelnemers aan deze studie waren tweedejaars studenten van een zesjarige medische opleiding in Saudi-Arabië.
Deze studie liet zien dat de hypothetisch-deductieve benadering, ten opzichte van de zelf-uitleggende benadering, inderdaad leidde tot de overweging van een groter aantal alternatieve diagnoses tijdens het oefenen van klinische casussen. Dit zou ook een verklaring kunnen zijn van het betere resultaat wat de hypothetisch-deductieve benadering opleverde, ten opzichte van de zelf-uitleggende benadering, in de diagnostische prestatie van de medische studenten; een bevinding die opnieuw werd aangetoond in deze studie bij de diagnose van ziektes die enigszins afweken van degene die eerder werden onderzocht. Vervolgonderzoek is nodig om aan te tonen of ouderejaars studenten ook zouden kunnen profiteren van de hypothetisch-deductieve benadering en of dit kleine voordeel, ten opzichte van de zelf-uitleggende benadering, behouden blijft over de tijd.

Beperkingen van de studies

In de volgende punten worden de beperkingen van de studies samengevat:

Één van de beperkingen van de eerste studie is het kleine aantal deelnemers. Echter bleek dat het instrument wel interne consistent was voor de eigen waarneming van professionaliteit onder artsen in opleiding, en daarom ook betrouwbaar is om te gebruiken. Daarnaast is er een andere, meer uitgebreide schaal met 36 items ontwikkeld om professionaliteit in kaart te brengen onder medisch studenten, artsen (in opleiding), waarin alle elementen van professionaliteit zoals geadviseerd door de Amerikaanse bestuur van Interne Geneeskunde (ABIM), werden meegenomen. Het gebruik van deze schaal zou mogelijk meer gedetailleerde resultaten hebben opgeleverd.

Één van de beperkingen van de tweede studie is het feit dat er slechts een uitleggend overzicht gegeven kon worden (narrative review). Dit was echter de beste manier om de resultaten te beschrijven vanwege het kleine aantal studies en vanwege de verschillende conclusies. De keuze om een uitleggend overzicht (narrative review) te geven was geen keuze die voorafgaand aan de studie was gemaakt, maar het resultaat van het kleine aantal studies wat beschikbaar was. Dit zou invloed kunnen hebben op de generalisatie van de

resultaten. De richtlijnen voor het schrijven van een uitleggend overzicht (narrative review) zijn echter nauwkeurig gevolgd.

Één van de belangrijkste beperkingen van de derde studie is het kleine aantal medische studenten wat al eerder een bacheloropleiding had gevolgd (n=54) ten opzichte van het aantal studenten wat direct na de middelbare school begonnen was aan de medische opleiding (n=196), wat mogelijk de generalisatie van de resultaten beperkt. Daarnaast zijn ook enkel mannelijke studenten geïncludeerd in de studie, omdat vrouwelijke studenten pas later in het programma zijn opgenomen. Als laatste is het belangrijk om te realiseren dat het meten van professionaliteit complexer is dan alleen het vastleggen van het aantal waarschuwingsbrieven per student. Andere instrumenten om professionaliteit te meten zijn nodig om deze twee groepen studenten goed met elkaar te kunnen vergelijken.
Ook de vierde studie had een aantal beperkingen. Als eerste rapporteerden een aantal van de begeleiders van de studie dat studenten in de groep van de zelf-uitleggende benadering moeite hadden om uitleg te geven bij mechanismen en principes van de symptomen van verschillende klinische casussen. Het bleek dat zij al veel waren vergeten van de basis die ze eerder hadden geleerd, of ze hadden moeite met het toepassen van pathofysiologie bij verschillende klinische casussen. Als tweede bleek dat de hypothetisch-deductieve benadering de studenten meer dan één hypothese liet overwegen, waar de zelf-uitleggende benadering dit niet toe liet. Het feit dat de casussen in de leerfase niet hetzelfde waren als in de testfase heeft er mogelijk toe geleid dat degene die meerdere diagnoses overwogen ook één of meer diagnoses overwogen in de testfase, wat hen enigszins een voordeel gaf ten opzichte van de zelf-uitleggende benadering. Een derde factor, wat een mogelijk voordeel was voor de hypothetisch-deductieve benadering, is dat de experimentele setup van deze studie ons forceerde om beide groepen studenten dezelfde patiënteninformatie te geven, zelfs in het geval dat de studenten die de hypothetisch-deductieve benadering toepasten er niet om vroegen. Een vierde beperking van deze studie is dat beide groepen verrassend laag presteerden. De deelnemers hadden een gemiddelde scores van 0.20 op een schaal van 0 tot 1, wat een stuk lager is dan de resultaten van studenten in soortgelijke studies.
Een beperking van de vijfde studie komt voort uit de keuze om het effect van de verschillende benaderingen in kleine groepen te onderzoeken wanneer studenten met verschillende begeleiders werkten. Ondanks dat deze keuze de werkelijke condities benadert waarin studenten een cursus klinisch redeneren volgen, opent het ook de deur voor groepsdiscussies wat het resultaat kan beïnvloeden. Wanneer studenten individueel getest worden, zoals gebeurde in voorgaand onderzoek volgens de zelf-uitleggende benadering, is er veel meer controle over de uitwisseling van informatie wanneer studenten aan de casus werkten. Een andere beperking van de studie is het lage resultaat van de studenten op de test. De scores met betrekking tot de diagnostische nauwkeurigheid waren substantieel lager dan in eerdere onderzoeken (12, 18). Men kan

zich afvragen of de studenten in de zelf-uitleggende conditie wel werkelijk in staat waren om genoeg biomedische kennis te activeren om coherente pathofysiologische processen te kunnen benoemen. Als laatste kan het ook zo zijn dat studenten die voorafgaand aan de test al meer kennis van de ziektes hadden minder voordelen hebben van de hypothetisch-deductieve benadering.

Onderzoeksvragen voor vervolgonderzoek

Ondanks dat onze studies in deze thesis over professionaliteit en klinisch redeneren bruikbare wetenschappelijke inzichten geven, is vervolgonderzoek nodig om deze bevindingen aan te vullen en om de bovengenoemde beperkingen te kunnen opvangen. De volgende onderzoeksvragen kunnen centraal staan in vervolgonderzoek:
De huidige kaders voor professionaliteit zijn gebaseerd en focussen zich op de medische praktijk, en leggen minder de nadruk op het medisch onderwijs. Wat is het effect van professionaliteit op de academische prestatie, motivatie en professionele identiteit van studenten?
De huidige kaders voor professionaliteit worden alleen beschreven aan de hand van de eigenschappen, zonder factoren welke ook invloed kunnen hebben op deze eigenschappen, zoals persoonlijke waarden, culturen en rolmodellen. Wat zijn andere factoren die kunnen bijdragen aan professionaliteit naast deze eigenschappen?
De kaders voor professionaliteit zijn niet beschreven volgens een causaal model, zoals achtergrond, proces en impact. Kan professionaliteit worden beschreven volgens een causaal model, met achtergrond, proces, output en factoren die van invloed zijn?
Het beschrijven van slechts één van de eigenschappen heeft de toepasbaarheid beperkt om meetbare leerresultaten te kunnen bepalen in het medisch onderwijs. Wat zijn meetbare leerresultaten om professionaliteit in medisch onderwijs in kaart te kunnen brengen?
De kaders voor professionaliteit zijn grotendeels theoretisch maar nog niet empirisch getest met behulp van een redelijke dataset. Kunnen deze kaders voor professionaliteit empirisch getest worden in het medisch onderwijs?
Toekomstige onderzoeksvragen voor het leren van klinisch redeneren zouden kunnen zijn: Wat zijn de effecten van andere factoren zoals hardop denken, het maken van een conceptplan of een mindmap, onderwijs van leeftijdsgenoten en reflecties?

Om de genoemde beperkingen recht te kunnen zetten stellen we voor om een uitgebreid cultuursensitief causaal kader te gebruiken voor professionaliteit op basis van drie niveaus, wat beter kan worden toegepast in het medisch onderwijs van het College van Geneeskunde, King Saud bin Abdulaziz Universiteit voor Gezondheids-wetenschappen (zie figuur 7.1). Dit palmboomkader bestaat uit drie niveaus, beginnend bij de achtergrondfactoren, de wortels, zoals cultuur, persoonlijke karakteristieken, institutionele

en omgevingsfactoren. Deze factoren zijn vastgesteld op basis van eerder genoemde resultaten van het onderzoek. Het tweede niveau, de stam, bestaat uit de eigenschappen als factoren welke zijn gebaseerd op andere modellen. De derde laag, de vruchten, legt de vertaalslag van de eigenschappen naar de leeruitkomsten, zoals professionele identiteit, gedrag en academische prestaties die medisch onderwijs kunnen begeleiden. Dit uitgebreide kader met drie lagen moet echter verder worden ontwikkeld en empirisch worden getest.

Abridged CV

Abridged CV

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Portfolio

1. Bidirectional versions in partial secondarily generalized convulsions – EEG correlations. **A. Al Rumayyan**, H Darwish, & N Pillay. Study completed. Journal of Neurological Sciences Vol. 187 Supplement 1, June 15, 2001.

2. Abnormal cerebellar development and axonal decussation to mutations in AHI1 in Joubert Syndrome, by Russell J. Ferland,Wafaa Eyaid, Randall V. Collura, Laura D. Tully, R. Sean Hill, Doha Al-Nouri**, Ahmed Al-Rumayyan**, Meral Topcu, Generoso Gascon, Adria Bodell, Yin Yao Shugart, Maryellen Ruvolo, Christopher A. Walsh. Nat Genet. 2004 Sep;36(9):1008-13. Epub 2004 Aug 22

3. Pediatric Residents Perceptions of Professionalism in Riyadh, Saudi Arabia. **Ahmed R. Al Rumayyan**. The New Egyptian Journal of Medicine Vol.:46;No.:5 1st May 2012

4. Prevalence and prediction of abnormal CT scan in pediatric patients presenting with a first seizure. **Al-Rumayyan AR**, Abolfotouh MA, Neurosciences (Riyadh). 2012 Oct;17(4):352-6.

5. International Handbook of Medical Education: An Introduction to Assessment. Mohi Eldin Magzoub, Hanan Al Kadri, Margaret Elzubeir, Amir Omair, **Ahmed Al Rumayyan**, Cees van der Vleuten. Sage Publications 2012:233-244

6. Biotin-responsive basal ganglia disease should be renamed biotin-thiamine-responsive basal ganglia disease: a retrospective review of the clinical, radiological and molecular findings of 18 new cases. Alfadhel M1, Almuntashri M, Jadah RH, Bashiri FA, Al Rifai MT, Al Shalaan H, Al Balwi M, **Al Rumayan A**, Eyaid W, Al-Twaijri W. Orphanet J Rare Dis. 2013 Jun 6;8:83. doi: 10.1186/1750-1172-8-83.

7. Case Reports: Cerebral sinus venous thrombosis in a child with nephrotic syndrome. **Al-Rumayyan AR**, Neurosciences (Riyadh). 2014 Apr;19(2):127-9.

8. Shared clinical decision making: A Saudi Arabian perspective: Ali Al Haqwi, Turki M. AlDrees, **Ahmad AlRumayyan**, Ali I. AlFarhan, Sultan S. Alotaibi, Hesham I. AlKhashan, Motasim Badri, Saudi Med J 2015; Vol.36 (12) 1472:1476

9. Early-Onset Parkinsonism in a 5-year old Child: Report and Review, **Al-Rumayyan A**, Klein C, Alfadhel M, Pediatric Neurology (2015), doi: 10.1016/j.pediatrneurol.2015.06.005

10. Patient desire and preferences for provision of information, Riyadh, Saudi Arabia: towards a more involvement in shared care. AlHaqwi AL, AlDrees TM, **AlRumayyan AR**, AlFarhan AI, Badri M. Saudi Med Med Sci 2016;4:172-7
11. Medical Professionalism Frameworks across Non-Western Cultures: A narrative overview. **Al Rumayyan A**, Van Mook WNKA, Magzoub ME, Al-Eraky MM, Ferwana M,

Khan A, Dolman D**.** Medical Teacher Saudi Supplement Med Teach. 2017 Apr;39 (sup1):S8-S14. doi: 10.1080/0142159X.2016.1254740. Epub 2017 Mar 5.

12. Clinical exome sequencing: results from 2819 samples reflecting 1000 families. Daniel Trujillano, Aida M Bertoli-Avella, **Rumayyan A** et al. European Journal of Human Genetics (2017) 25, 176–182; doi:10.1038/ejhg.2016.146; published online 16 November 2016

13. High school versus graduate entry in a Saudi medical school – is there any difference in academic performance and professionalism lapses? **Al Rumayyan AR**, Al Zahrani AA, Hameed TK. BMC Med Educ. 2016 Dec 19;16(1):315.

14. Neurological Complications among Pediatric post Liver Transplant in King Abdulaziz Medical City-Riyadh. Alanoud Al-Marzoug,Hala Al-Marzoug, **Ahmed Al-Rumayyan** and Abdullah Al-Zaben. International Journal of Advanced Research. Int. J. Adv. Res. 4(10), 1748-1454 ISSN: 2320-5407

15. Expanding the genetic heterogeneity of intellectual disability. Shams Anazi1 Sateesh Maddirevula, Vincenzo Salpietro, Yasmine T. Asi, Saud Alsahli, Amal Alhashem, Hanan E. Shamseldin, Fatema AlZahrani, Nisha Patel, Niema Ibrahim,·Firdous M. Abdulwahab, Mais Hashem, Nadia Alhashmi, Fathiya Al Murshedi, Adila Al Kindy, Ahmad Alshaer, **Ahmed Rumayyan.** Hum Genet. 2018 Jan;137(1):105-109. doi: 10.1007/s00439-017-1859-7.

16. Further delineation of the phenotypic spectrum of ISCA2 defect: A report of ten new cases. Majid Alfadhel, Marwan Nashabat, Muhammad Talal Alrifai, Hesham Alshaalan, Fuad Al Mutairi, Saif A. Al-Shahrani, Barbara Plecko, Rawan Almass, Maysoon Alsagob, Faten B. Almutairi, **Ahmed Al-Rumayyan**, Waleed Al-Twaijri, Mohammed Al-Owain, Robert W. Taylor, Namik Kaya. Eur J Paediatr Neurol. 2018 Jan;22(1):46-55. doi: 10.1016/j.ejpn.2017.10.003. Epub 2017 Oct 16.

17. PRUNE Syndrome Is a New Neurodevelopmental Disorder: Report and Review. Majid Alfadhel, MD, FCCMG1, Marwan Nashabat,, Khalid Hundallah, Amal Al Hashem, **Ahmed Alrumayyan**, and Brahim Tabarki. Child Neurol Open. 2018 Jan 11;5:2329048X17752237. doi: 10.1177/2329048X17752237. eCollection 2018.

18. Teaching clinical reasoning through hypothetico-deduction is (slightly) better than self-explanation in tutorial groups: An experimental study. **Al Rumayyan A**, Ahmed N, Al Subait R, Al Ghamdi G, Mohammed Mahzari M, Awad Mohamed T, Rotgans JI, Donmez M, Mamede S, Schmidt HG. Perspect Med Educ. 2018 Apr;7(2):93-99. doi: 10.1007/s40037-018-0409-x.
19. Familial Hemiplegic Migraine with Prolonged Coma and Hyperthermia: ATP1A2 Gene Mutation Case Report in a Single Saudi Family. Assiri S, Almalki F, **Al Rumyyan A**, Altwaijri W. JBCGenetics. 2019; 2(1): 85-90

20. Teaching Clinical Reasoning: An Experiment Comparing the Effects of Small-group Hypothetico-deduction Versus Self-explanation. **Ahmed Al Rumayyan**, Silvia Mamede, Henk G. Schmidt, Walther N.K.A. van Mook. **Submitted 11 March 2019.** Journal of Medical Education

21. Prevalence and outcomes of Guillain-Barré syndrome among pediatrics in Saudi Arabia: a 10-year retrospective study. Asiri S, Altwaijri WA, Ba-Armah D, **Al Rumayyan A**, Alrifai MT, Salam M, Almutairi AF. Neuropsychiatr Dis Treat. 2019 Mar 1;15:627-635. doi: 10.2147/NDT.S187994. eCollection 2019.

22. Clinical Presentation and outcome of acute disseminated encephalomyelitis in Saudi Arabia. Tertiary Center Experience. Aldamkh BA, Alamer AF, Altuwaijri MM, **Alrumayyan MA**, Alhaqbani AH, Alharthi NA, Aldamkh SA, Aldrees AS, Alrifai MT, Altuwaijri W, Alrumayyan A. Neurosciences (Riyadh). 2019 Apr;24(2):89-94. doi: 10.17712/nsj.2019.2.20180017.

23. Targeted SLC19A3 gene sequencing of 3000 Saudi newborn: a pilot study toward newborn screening. Alfadhel M, Umair M, Almuzzaini B, Alsaif S, AlMohaimeed SA, Almashary MA, Alharbi W, Alayyar L, Alasiri A, Ballow M, AlAbdulrahman A, Alaujan M, Nashabat M, Al-Odaib A, Altwaijri W, **Al-Rumayyan A**, Alrifai MT, Alfares A, AlBalwi M, Tabarki B. Ann Clin Transl Neurol. 2019 Oct;6(10):2097-2103. doi: 10.1002/acn3.50898. Epub 2019 Sep 26.

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