How to train clinical reasoning in nursing students

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Actionable knowledge

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VRIJE UNIVERSITEIT

HOW TO TRAIN CLINICAL REASONING IN NURSING STUDENTS

Actionable knowledge

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Chapter 1
Introduction

My interest in clinical reasoning started in 1985, when I started as a nurse on the neurology ward for women. From the doctors and my nursing colleagues, I learned to observe what patients show, and listen to what they tell. The patients, particularly those who could not talk, taught me to read their discrete signals to indicate their needs. Other patients, or their relatives, told me about their fears and pleasures in life. As a nurse, and later as a teacher and researcher, I was curious about how a patient's story leads to conclusions and actions of healthcare providers. Even as a bachelor nursing student I was interested in what connects patient data to actions. I graduated in 1985 with a thesis about intuition in the nursing process. In those early years of my career, the term clinical reasoning was not yet used. We, the nurses in the neurology department, considered ourselves detectives. Together with physicians and paramedics, we aimed to detect what was going on. The cues (signs and symptoms), combined with knowledge about neurological diseases and the brain informed our discussions. Thereby, we observed how the patients responded to the interventions, and tried to infer what the major obstacles were for patients to gain their independence again. The patients taught us about themselves, neurology and nursing. In 2000, in the health professionals' list of competencies, this process of observing, thinking, inferencing, and discussing was coined 'clinical reasoning' (1-4).

Clinical reasoning in nursing

Clinical reasoning, defined

In healthcare professions, as in nursing, a kaleidoscope of terms is used to describe the processes leading from a patient and his problem to sound caring practices. Young et al. (5, 6) found 106 related terms in the health professions literature. Problem solving, decision making, critical thinking, and clinical judgment are a few terms also used in nursing. Problem solving and critical thinking can be considered as necessary generic skills to reason, not specific for a profession or task. Clinical judgment and decision making in nursing can be considered as the visible expression (in actions or behaviour) of the clinical reasoning process. Clinical judgment and clinical reasoning may concern a patient or a specific care situation. For this thesis we define clinical reasoning as follows:

> Clinical reasoning is, "*a complex process that uses cognition, metacognition and discipline-specific knowledge to gather and analyse patient information, evaluate its significance, and weigh alternative actions"* (7).

Types of reasoning

Dobber et al. (8) distinguish four questions that trigger nursing clinical reasoning: What is the matter with my patient? How did this problem arise? What will be the course of this problem and what can we achieve? and, What can we do about it? As in medicine, these types of reasoning can be characterized as: diagnostic, etiological, prognostic and therapeutic or management reasoning respectively.

What is already known about clinical reasoning?

Clinical reasoning has been studied as a cognitive process, as a result of memory and knowledge structures, as an analytical or intuitive approach, or as a joint activity of members of a care team. In the 1970s, research to explain clinical reasoning focused on the cognitive processes to solve problems. Professionals formulate and test the hypothesis about the problem; this is called the hypothetico-deductive approach. This model could not explain how experts generated more adequate hypotheses as compared to novices, and why this happened only in their field of expertise (9, 10) . Studies about memory, the role of knowledge and the differences between experts and students followed in the 1980s. Research showed that experts in a specific field build knowledge structures in their memory, based on patient encounters. Differences between students and experts in solving a diagnostic problem were explained by differences in knowledge structures and not by differences in problem analysis (10-12). Therefore, clinical reasoning is context-dependent (13, 14) The next angle were investigations about analytical or intuitive approaches to explain clinical reasoning, either as a dual process, or as located on a continuum (15). With the growing attention to interprofessional collaboration in healthcare, currently clinical reasoning is considered to be shaped not only by cognition but also by context and dialogue. (10, 16). Clinical reasoning has been investigated for many years in all health professions (10, 17). However, a full understanding, a consistent and joint conceptualisation of clinical reasoning is still lacking. And more importantly, the teaching strategies to guide nurses to hone excellent reasoning skills, that patients with growing complexity deserve, are not fully understood (18, 19).

Role of theoretical knowledge.

Although knowledge is a necessary prerequisite of reasoning, knowledge of basic sciences doesn't fully explain differences in clinical reasoning of students and experts. As yet there is no evidence that knowledge of basic sciences and diagnostic performance of physicians are directly related. Knowledge acquired through experiences with patients, clinical experiential knowledge, seems to be more important (20). Currently the idea is supported that experts have encapsulated their knowledge. This means that basic science knowledge is nested and summarised within clinical knowledge. Clinical experience, long or short transformed into clinical knowledge plays an important role in clinical reasoning (20-22). This is the case in experts but is also found in beginners. In addition to these two types of knowledge, experts also use typical contextual information that is related to risk of diseases and probability of diagnoses (20). In nursing, the schools provide knowledge in basic health,

medical and nursing sciences, including psychology and sociology, the body of knowledge in nursing. Nonetheless in nursing, just like in medicine, a direct relationship between formal knowledge and clinical reasoning has not been reported (23).

The nursing training in practice starts in the first year of nursing education. This early introduction to real patients strengthens clinical knowledge. However, there is still a gap in the (nursing) literature on how to facilitate the transfer of basic sciences into everyday learning, and how to connect previous theoretical knowledge to new experiential knowledge (24).

Knowing the patient

In the literature, knowing the patient is emphasized as a key aspect in nursing. Knowing the patient contributes to patient safety and to patient participation (25). Nurses want to know their patient 'as a person', to learn about the patient's experiences of illness, his life story and lifestyle. Most important, they want to know how a patient typically responds to treatments or how he expresses his complaints and how he understands his current situation in terms of quality of life and his goals in life. Nurses show themselves as a person to get acquainted with their patient. Knowing the patient is important to judge what is salient and what not, to observe discrete changes, to individualise interventions and to establish a caring relationship (26, 27). Thus, besides theoretical and clinical knowledge, nurses have a subjective perspective on understanding a patient in his situation. To receive new patients, nurses collect their expectations based on theoretical and clinical knowledge; they take a mental 'picture' and try to fill in the 'white pixels' early in the encounter. Nursing students find knowing the patient as a prerequisite for taking responsibility for the patient (27).

Patient safety

Knowing your patient and reasoning about his problem(s) or situation is the core of nursing and all the disciplines nurses collaborate with. Many manuscripts about clinical reasoning stress the importance and substantiate its urgency by relating clinical reasoning with patient safety (28, 29). The medical literature is abundant on flaws in reasoning, diagnostic errors and cognitive bias causing harm to patients (30). Croskerry (31) argues that medical errors are often diagnostic errors, and that these errors do not occur because of knowledge deficits or health system issues, but because of thinking flaws. This asks health professions education to move the focus from content to critical and clinical thinking skills (30). In the nursing literature, identifying patients at risk of deterioration is more prominent topic. Nurses with poor reasoning skills do not recognize early warning signs of a patient (for example a change in breathing rhythm); they fail to diagnose and fail to take the right actions (32-34). In short, clinical reasoning skills seem to be associated with patient outcomes. Sound clinical reasoning is important for professionals and is a "need to learn" for nursing students and a "need to teach" for all involved in educating students.

Learning and teaching clinical reasoning in practice settings

The clinical teaching setting and its participants

The clinical training of nursing students starts in the first year of the nursing study. In the Netherlands, nursing can be studied at two levels: bachelor and vocational. A four-year bachelor or vocational training leads to the nursing certificate and registration. The number of practice hours required by the EU requirement is 2300 hours (35). The training program has either an employed apprenticeship character or a traineeship with yearly clinical placements of 5 to 30 weeks. Nursing students learn through participating and doing. They learn "at work, through work and for work" (36). Compared to medical internships, the nursing workplace learning and teaching is less focused on the acquisition of knowledge and more on becoming a well-trained member of the nursing team, and on developing a nurse identity (37-39). The nursing students learn experientially, formally guided by competency sets and learning goals, through different care and patient situations. They learn from role models and through mentoring. Experienced nurses mutually engage with two or more students, to teach skills and professional strategies (40). These mentors are the towers of strength for students, who have to cope with a busy, unstructured practice of multidimensional nursing activities for more than one patient, in collaboration with other professionals with time pressure and safety concerns. The students have to apply theoretical knowledge to clinical practice and integrate basic science knowledge and clinical knowledge (20). This may be hampered by the unpreparedness of students for the added complexity of reality or fear of making mistakes (24). Several clinical educational models exist to parlay the difficulties of clinical learning (41).

In the setting of studies reported in this thesis. (two large university hospitals), the model of Dedicated Educational Units (DEU) prevails. DEUs are academic-practice partnerships (42). Faculty of the nursing schools join the students in practice on a regular basis to teach, to relate clinical experiences to theoretical knowledge and also to bring the principles of evidence-based practice and quality improvement into practice. In these last two activities graduate nurses are invited to participate. The nurses, as mentors, are trained to coach two or more students during a shift. They are role models and are responsible for the learning experiences of the students and the patient care provided by the students. The mentors provide instruction, and assess knowledge, attitudes and skills in order to entrust patients to the students. Moreover, the mentors are responsible to guide the students in the development of self-regulated learning, critical thinking and clinical reasoning (42).

The mentors collaborate with nurse educators to integrate three topics of clinical learning: relating theoretical knowledge to clinical experiences, instructing on (communication) skills and role modelling ethical standards and professional responsibilities. Every DEU has a certified nurse educator. A nurse educator is employed by the hospital and facilitates and guides nursing students in learning at and from work. They supervise the processes between student and mentors, use interpersonal skills and professional competency in clinical knowledge and the 'art of nursing' (43, 44). Nurse educators coach both mentors and students.

Today's student

The students are young adults, or career switchers, some of them with own families to care for. They learn four days a week in our practice on DEUs during practice placements. Student nurses start their education with a motivation to want to help, to be of significance for those who are ill or in need. Nursing students have a personal identity, but as nurses, they also identify themselves with a group of nursing professionals. Driven by compassion, based on knowledge and judgment, (student) nurses connect doing and thinking in their motivation to care (45).

Educational theories and frameworks used in this thesis

Three major learning and teaching theories or models can be identified in the educational clinical reasoning literature and each one of them influences the choices made on educational content, strategies and assessment (18, 19, 24, 46-48).

Skills acquisition model

Educational investigators have strived to deepen their understanding of learning through comparing experts and beginners of a certain profession. The Skills Acquisition model of Dreyfus and Dreyfus (the original model is published in 1979) (49) is the foundation for this approach. In nursing, Benner (50) identified two axes to explain differences between beginners and professionals at different levels of expertise. They differ in their reliance on abstract, theoretical principles (beginners) or more on own experiential knowledge (experts). Moreover, beginners perceive the elements of a situation, while the experts perceive an indivisible whole. Clinical reasoning investigators worked within Information processing theory on questions about attention, information processing, memory and retrieval from memory (40, 51). Schmidt and Boshuizen (52) identified several shifts in knowledge structures in memory to explain why experts are better diagnosticians than students. Medical students move from building causal networks, to knowledge encapsulation (summarizing details in a more abstract concept), to illness scripts, varying in generality (22). Illness scripts are personal, they are mentally organized knowledge structures in long term memory. Illness script investigations led to the development of illness script theory. This theory proposes that scripts develop through real life experiences. The theory identifies different components in the scripts obtained: the fault, the pathology or malfunctioning, the consequences, the signs and symptoms and enabling conditions, the background and contextual information (53). Illness scripts grow through exposure and experience. Differences in the structure of illness scripts are observed in novices, experienced professionals, and experts. Illness scripts enable the professional to perceive a patient situation, to give meaning and to hypothesize. The extent of the enabling conditions in memory distinguishes the expert from the novice. Experts mention in think-aloud studies more non-medical information and less pathophysiology, when suggesting a diagnosis (12, 54). Illness scripts can be considered prerequisites for clinical reasoning (55). Studies on illness script formation have informed medical education and

assessment of clinical reasoning competency and have resulted in the script concordance test (56, 57).

Self-regulated learning theory

Learning and the variables leading to learning, such as knowledge activation or critical thinking, can be explained by Self-regulated learning theory (SRL) (58-60). The regulation addresses cognition, motivation and affect, behaviour and context. Students are viewed as active participants, who set goals and construct meaning. It is assumed that students try to regulate and monitor their learning processes. SRL is goal-oriented learning. The learner, the learning content and the context interact, and affect the self-regulating activities of the student. Self-regulated learning distinguishes four phases in learning: forethought, monitoring, control, and reaction combined with reflection. Students plan, set aims, they perform and monitor their actions, and evaluate and reflect afterwards. So, learning is guided by cognition, metacognition, emotion, motivation and context. Self-regulated learning skills have to be learned and guided; the learning context has to facilitate students' self-regulation. Educators and mentors can stimulate reflection before, during and after learning activities. Self-regulated learning is a guiding principle of the DEUs. Students set daily learning objectives, pre-discuss the day, ask for feedback and evaluate and reflect on their day. For the development of clinical reasoning skills both cognitive and metacognitive dimensions of nursing reasoning need attention; general critical thinking and problem-solving skills need to be paired with specific clinical knowledge (59, 61). Due to Self-regulated learning theory, metacognition, motivation, emotion and context can be added to the skills acquisition model to explain the learning of clinical reasoning.

Situativity theory

Situativity theory proposes the relation between learning and the learning context (62). Thinking and learning are dependent on experience and context. Within the different situativity models, the environment is as important as the learner, as is the interaction with others. Students learn through interaction with peers, patients, mentors and other members of a team. Situativity may explain why it is difficult to transfer knowledge from one situation to another, from school to practice or from one patient to the other. If we look at teaching and learning clinical reasoning through a situativity lens, then it is not brain, memory or metacognition, but it is the environment, interaction with others and the specificity of experiences, that matter more (16, 62).

Barriers and strategies in teaching and learning clinical reasoning

Although clinical reasoning is found to be important, has been studied for many years, and theories can guide teachers and educationalists, there exist many barriers to learning and teaching it. Even if clinical reasoning is included in the curriculum, which is not always the case (63), several hurdles exist. Some of the barriers can be found among the students, the teaching environment, the faculty, mentors and nurses, the interactions, the difficulty of understanding

clinical reasoning and the difficulty of assessing clinical reasoning, lack of practical guidelines to teach, lack of time and the overload of information in clinical practices, and the developmental differences between novices and experts (13, 22, 28, 63-68). All these barriers make the case for systematic teaching strategies to convey the agreed content along with instruments to evaluate clinical reasoning.

To date, different clinical teaching strategies have been identified and studied. Brown Tyo and McCurry (19) have highlighted two gaps in the literature on teaching clinical reasoning: the difficulty to identify effective teaching strategies and the difficulty to evaluate their effectiveness. Strategies that have been described for clinical teaching or guiding are: questioning (69), self-explanation by students (70), thinking aloud (19), different forms of reflection (19, 71, 72) and also training of communication skills, so that students can discuss their inferences, establish a relation with the patient and can collaborate in decision-making (71). Collaborative learning, with structured clinical coaching, forms of debriefing are also deployed to enrich clinical reasoning (19), as are making drawings like concept maps or mind maps (72). In a study on midwifery students, Baloyi and Mtshali (46) found that the development of reasoning skills is enhanced when schools and clinics collaborate in teaching and share the same theory of skills development. The process of learning in which a student, guided by a mentor, experiences how to apply knowledge, to observe, to participate in solving real problems, may be as important as the outcomes of this learning.

Despite these plentiful research results, an all-convincing research-based strategy for the clinical guidance of nursing students to enhance the development of reasoning skills is needed. Many mentors are not educated themselves in clinical reasoning or in teaching clinical reasoning (73). Many of the strategies are based on 'giving words' to experiences and observations, to articulate them. This may be complex, not only for students, but also for their supervisors.

The PhD research project

Broad research question

In response to the above outlined status of clinical reasoning in nursing, we aimed to improve clinical reasoning education of nursing students in practice for the benefit of patients. We are driven by the urgency to fill the knowledge gaps, fuelled by engagement in patient care and nursing education in practice. Hence, from this engaged stance, we aimed to gain more understanding, relevant to practice; thus, generate actionable knowledge (74, 75). Actionable knowledge connects science to everyday practice. Actionable knowledge is justified by evidence, based on reliable methods, with practical relevance to the question or problem (76).

Our broad research question was:

> *'How is clinical reasoning conceptualized and shaped in nursing and how can this be applied to clinical teaching and evaluation?'*

Paradigm

The overall aim to deepen our understanding of clinical reasoning in nursing is the base of the choices we made to investigate clinical reasoning. Guided by our research questions, our work can best be characterized by the interpretivist or post-positivist paradigms. This has implications for our view on the nature of reality, the nature of knowledge, and for approaches in data collection and analysis. The reality of nursing and teaching in practice is complex and diverse, shaped by patients, cultural and organizational influences, networks of collaboration and personal relationships. We view knowledge gained by investigations, as subjective, constructed through interaction between researchers and participants, shaped by time and place. The overall nature of inquiry is descriptive or explorative, in order to understand, and less to explain or to test. The chosen methods to collect data reflect this stance: we used qualitative or mixed methods to capture the various facets of clinical reasoning. Also, the quantitative data are never really assumed to be objective, the values and voices of the participants are included influenced the results. In the analysis we switch between induction and deduction, to relate personal experiences of participants to theories (77, 78).

Reflexivity and research team

The research team around me (the PhD candidate), shares the ambition to improve education through rigorous research projects, for the benefit of students and patients. The team brings together differences in experience and background, focusing on learning and clinical reasoning. The project is supervised by a medical doctor and the program leader in research in health professions education. One of the team members is a lecturer in nursing and author of an educational method in clinical reasoning. And another is an educational psychologist and researcher in illness scripts in medicine. One of the co-supervisors passed away during the project. He was an MD, specialized in teaching clinical reasoning to general practitioners and translational research in medical education. During investigations, other researchers joined the team: a nursing teacher, a medical teacher, research assistants and a lecturer in evidence-based practice. The nursing lecturer and the PhD candidate have prolonged commitment to nursing, nursing education and the learning of nursing students. The PhD candidate worked as a nurse, as a nurse manager, project leader and as a nurse educator. She studied nursing, and has a master's in teaching and clinical epidemiology. The research team conceptualized the studies and participated in the analysis and reporting. The PhD candidate and one research assistant had contact with participants: nurses, students, mentors and nurse educators. We acknowledge our subjectivity in the whole thesis project (79).

Although nursing education takes place in schools and workplaces in psychiatry, nursing homes, and in the community, we limited our research focus to our own arena: hospital care.

Thesis Outline

Our broad research question,

'*How is clinical reasoning conceptualized and shaped in nursing and how can this be applied to clinical teaching and evaluation?*'

was operationalized in four themes: defining, shaping, teaching and evaluating clinical reasoning. These themes were approached with specific research questions, and subsequently investigated with a chosen method. Table 1.1. depicts these choices.

Theme	Research question, objectives	Approach
Conceptualizing clinical reasoning in nursing How can clinical reasoning be understood?	What are the features of clinical reasoning of professional practitioners as described in the medical and nursing scientific literature and what can we learn about clinical reasoning from this simultaneous concept analysis?	Integrative review protocol *(Chapter 2.A.)* Integrative review, concept and layered analysis *(Chapter 2.B.)*
Shaping clinical reasoning How is the expertise of experienced nurses organized?	How well does illness script theory describe nurses' experience-based knowledge?	Qualitative Interview study, directed content analysis *(Chapter 3)*
Evaluating clinical reasoning How can growing expertise in clinical reasoning be evaluated?	To obtain a Dutch version of Lasater Clinical Judgment Rubric and to test its psychometric properties on nursing students during their hospital traineeship	Mixed Instrument Design Model to develop and validate *(Chapter 4)*
Teaching clinical reasoning How can we support teaching and learning in clinical practice?	How can we foster students to organize their experiential knowledge of patients through a debriefing procedure in clinical practice? Which supportive design principles can be distinguished from the design development process?	Design based research approach, iterative thematic analysis, mind map analysis *(Chapter 5)*
How does context interfere with educational innovation?	How can implementing new learning tools in hospital practice lead to sustainable change?	Theory and case based reflections *(Chapter 6)*
General Discussion		Summarizing and integrating research findings *(Chapter 7)*

Table 1.1. Thesis outline

A model, used to design education, can help to justify our choice to begin studying nursing *professionals*, while we are interested in teaching of nursing *students*. We chose the Didactic model of van Gelder (figure 1.1) which outlines systematic educational design and connects the learners with outcomes (80). According to this model, education must be designed, based on objectives, the intended skills and knowledge that characterize professionals. We can map our studies to this model, with the purpose to obtain actionable knowledge for the clinical teaching practice.

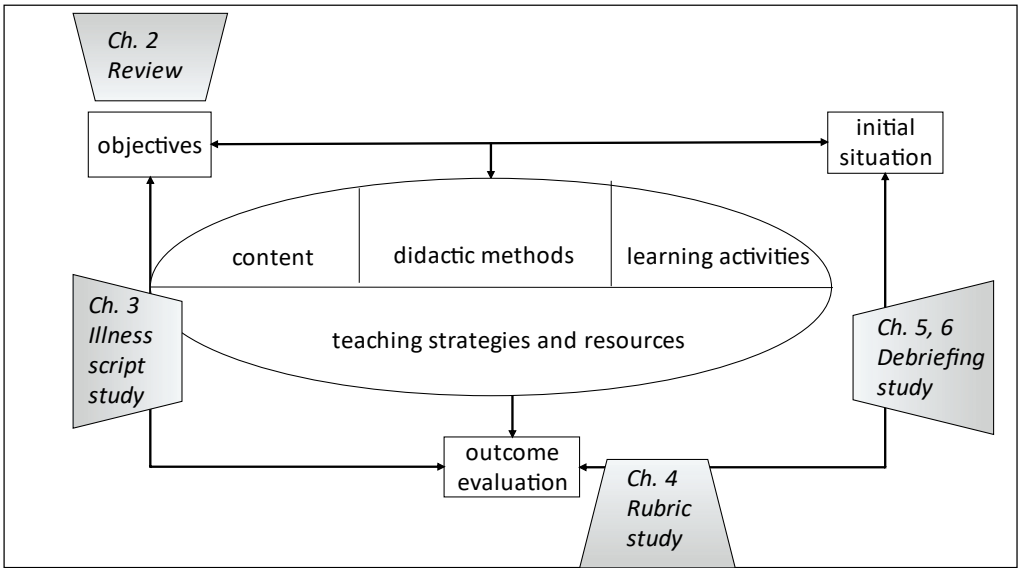

Figure 1.1. Thesis plan, mapped in the Didactic model of Van Gelder explained in Valcke (80).

Objectives	*What the student must achieve or master*
Content	*The selection and arrangement of teaching material*
Initial situation	*To connect with the student knowledge about his initial situation is needed*
Didactic methods	*Didactic work formats*
Learning activities	*Required activities of students like memorizing or taking initiative*
Teaching strategies and resources	*Appropriate media and teaching approaches*
Outcome evaluation	*Methods of establishing results of education*

Terminology used

For this thesis we made some choices in the terminology used. When we refer to students, we mean nursing students. In this work we use he or she interchangeably, usually for patients or students, so that no one feels excluded. The students learn in schools, the universities of applied sciences or vocational schools. They also learn in practice; we call these

periods ‘practice placements’ or ‘internships’. The learning that occurs in practice is called ‘clinical learning’ (81). ‘It takes a village to raise a nurse’ and in the literature many names and functions are used. We use faculty or teachers for those who work for schools and nursing educators for those who are employed by the hospital. On the wards, in everyday care, students are coached and supervised by many nurses. They have a special relationship with their mentors or supervisors: nurses who guide and evaluate the learning processes and outcomes.

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Chapter 2.A.
Reasoning like a doctor or like a nurse? An integrative review protocol

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Abstract

Introduction: Clinical reasoning, a major competency for all health professionals, has been defined and studied 'within' each profession. We don't know if content, process and outcomes are comparable 'between' physician and nursing clinical reasoning. This paper aims to set up a protocol for an integrative review to analyse and synthesise the scientific nursing and medical clinical reasoning literature. It builds on the history of nursing and medical clinical reasoning research and aims to create a higher level of conceptual clarity of clinical reasoning, to increase mutual understanding in collaboration in patient care, education and research.

Methods and analysis: This integrative review follows stepwise the methods described by Whittmore and Knafl: problem identification, literature search, data evaluation, data analysis and presentation. The initial systematic and comprehensive search strategy is developed in collaboration with the clinical librarian and is performed in electronic databases, PubMed, CINAHL, PsycInfo and Web of Science from March 30, 2020 - May 27 in 2020. Empirical and theoretical studies are included. This search will be accompanied by ancestry searching and purposeful sampling. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow chart will summarise the selection process. The quality of eligible studies will be evaluated with a checklist, suitable for diverse study methods. The data analysis is inspired by concept analysis of Walker and Avant and layered analysis of an intervention of Cianciolo and Regehr. We will extract the data of the included studies conform these layers and features, to capture the multi-facetted nature of clinical reasoning in both professions. The data will be presented in a validity matrix to facilitate comparing and contrasting.

Ethics and dissemination: Ethics approval is not required. The outcomes will be disseminated through conference presentations and publications.

Introduction

Clinical reasoning is an essential competency for all health professionals. Clinical reasoning has always been defined, practiced, researched, taught and guided 'within' the boundaries of each health profession. Within and between professions differences exist in terminology and connotations (1). However, all clinical reasoning starts with the meeting of a patient and his experiences. As an example, all health professionals encounter patients complaining of tiredness or exhaustion. From the patients' perspectives, fatigue disrupts their quality of life (2). From the health professionals' perspectives, fatigue could be a symptom, a state, a diagnosis, a rationale for therapy, a side-effect of treatment, a result of under- or overtraining, or an important prognostic factor in a patient management plan, depending on which health profession one belongs to. Thus, fatigue has a different position in the professional reasoning approaches of therapists, physicians and nurses.

Background

Clinical reasoning, which is a highly complex system with multiple inter-dependent mental activities (3), can be viewed from three perspectives: the process of reasoning, the knowledge structures, and the extent of analytical or intuitive cognitive modes (4). Clinical reasoning is considered a multifaceted concept, coupled with the potential for misunderstandings (5). In the clinical reasoning literature, concepts or terms like clinical judgment, decision making, critical thinking have been used, as surrogate or related terms or as synonyms (1, 5-7).

According to previous studies, differences in terminology, operationalisations, understanding and perspectives may hamper three domains: education and assessment (5, 8), collaboration and communication (9, 10), and research (11).

In education and assessment, Young (5) and Brown Tyo (8) state that the inconsistency in conceptualisation and terminology is a barrier in identifying effective teaching and assessment strategies. We learn from Muller-Juge (9) and Visser (10) about interprofessional collaboration, that residents and nurses have different perceptions and expectations about clinical reasoning of the other professional (9). Students of different professions could not fully understand their patients' condition, if they were not aware of the reasoning (process and outcomes) of their colleagues (10). In research, in a scoping review, clinical reasoning has been investigated as a cognitive, contextually situated or socially mediated activity, reflecting the multidimensionality of clinical reasoning (11). From the existing literature this review was triggered by: the multi-faceted characteristic of clinical reasoning and the lack of awareness of the clinical reasoning of other professionals in interprofessional teams.

Rationale

Hence, even though clinical reasoning has been extensively investigated, this has typically been carried out within a profession, while less attention has been paid to the differences and similarities between professions, like between medicine and nursing.

Since most research on clinical reasoning has been conducted in the medical profession, we also need to know if, and to what extent, these results can be generalized to the nursing domain. For example, both professions share an educational research tradition in studying the differences between novices and experts. However, Chiffi and Zanotti ((12) state that medicine is concerned with bio-functional alterations of a patient, and that nursing is focussed on independence in self-care and well-being.

Assuming that this is understood correctly, and that we do not know whether content, process and outcomes of clinical reasoning of physicians and nurses are comparable, this also creates uncertainty about the mutual transferability of research findings. If we could succeed to unravel and describe the differences and similarities between nurses' and physicians' reasoning, we may also learn more about the features of clinical reasoning in general and its impact on collaboration in patient care and research. Making clinical reasoning more explicit, may facilitate understanding among physicians and nurses and improve teaching, guidance and assessment of reasoning (5, 8). These possibilities call for further inquiry into clinical reasoning from both professional perspectives. To our knowledge, few comparative studies have been published and no systematic review of similarities and differences in reasoning.

Objectives

Because clinical reasoning is assumed to be a multifaceted concept, this investigation will have to consider all these facets, properties and relations, with the aim to 'peel the shells from this onion'.

We identified two methods of analysis for our study. Cianciolo and Regehr have described the layers of an educational intervention: philosophy, principles, techniques and contextual influences (13), and Walker and Avant have described the method of concept analysis. A concept is a mental construction and contains attributes, borders, antecedents and consequences (14). Therefore, through the lens of layers and concepts, our research questions are: what are the features of clinical reasoning of professional practitioners as described in medical and nursing scientific literature and what can we learn from this simultaneous concept analysis? Our broader aim is to create a higher level of conceptual clarity of clinical reasoning of nurses and physicians, to increase mutual understanding in collaboration in patient care, education and research.

Methods and Analysis

To answer our research question, we chose and will apply the integrative review method. The purpose of this method is to summarize and to critical analyse what is known about concepts, theories or methodologies, in order to report the current state of evidence and to identify future goals for research and practice. An integrative review has a broader research question than a systematic review, and follows a systematic, comprehensive, stepwise approach to increase the understanding of a phenomenon (15). Moreover, this method allows to include and combine empirical qualitative and quantitative studies and

theoretical articles like all types of reviews, to collect the whole spectrum of perspectives on the topic (16, 17). The integrative review method fits our aim and the rich, diverse literature on clinical reasoning.

Patient and public involvement

In this study, patients, students and educators are included only through inclusion of what is written about them in the published studies. The review process follows five stages, as shown in figure 2A.1. (16).

Figure 2A.1. Stages of integrative review

Problem identification

As described in the introduction, to alleviate the lack of explicit knowledge about how the clinical reasoning of one profession relates to that of the other, may help us to improve interprofessional collaboration, education and research.

Literature search

The use of more than one literature search procedure is recommended when conducting an integrative review (16). We planned two procedures to search: a systematic, comprehensive search strategy, followed by ancestry searching. This involves reviewing the references of included studies from the first procedure (18). Initially, the main researcher and a clinical librarian (JV, HK) searched comprehensively, from March 30 2020 - May 27 in 2020, from inception to date in PubMed, CINAHL, PsycInfo and Web of Science, with the search terms clinical reasoning, clinical decision making, clinical judg(e)ment, collaborative reasoning, diagnostic reasoning, reasoning inductive, deductive, inference, probability judgment of nurses and physicians (all specialties).The search terms were chosen mainly on the studies of Young (5) and Victor-Chmil, because they provide and explain the terminology used in clinical reasoning publications. (6). A worked-out search string is included in appendix 1.

As a third procedure, if the yield of the number of articles is too large to analyse, purposeful sampling can be considered (16, 19). Although clinical reasoning has been studied for many years, it only appeared in the competency or learning outcome descriptions after 2000 (20-22). Therefore, we decided to purposively sample the articles from 2000 onwards. Articles are included, based on the topic (clinical reasoning, clinical judg(e)ment, decision making (if related to the 'how' (descriptive) of reasoning), on the population (registered practicing nurses and physicians), with a focus on nursing and medical practice. Empirical (qualitative and quantitative) studies were included, as well as theoretical articles (literature reviews, scoping and systematic reviews, concept analysis and expert opinions). Articles about professional development and education, critical thinking, normative decision-making

strategies, case and disease descriptions, books and dissertations are excluded, since these documents are not deemed relevant for our research question. All articles are transferred to Rayyan, to support screening and selection (JV, RK). A Prisma flowchart will be used to summarize the selection process of studies, eligible for further analysis and synthesis.

Data evaluation (to be commenced)

To appraise the quality of included studies which are possibly methodologically diverse, we adapted the instrument developed for integrative reviews by Badu, et al. (23), by adding the criteria for text and opinions of Joanna Briggs Institute (24). A quality assessment is recommended by Toronto (15). For every type of study, the corresponding screening questions will be evaluated. Two reviewers will independently assess methodological quality. Articles are included in the next phase if they address the research question, and if the score according to their design is higher than 50%, expressing medium to high quality.

We refer to Appendix 2 for the critical appraisal instrument.

Data analysis

This phase consists of data extraction (categorizing and summarizing), data display, comparison and synthesis. Clinical reasoning can be studied from many angles, e.g. reasoning strategies, outcomes, skills or context (5). Inspired by concept analysis of Walker and Avant (14) and layered analysis of an educational intervention of Cianciolo and Regehr (13) and (25) we developed a data extraction form to investigate all layers, such as, content, attributes and perspectives of reasoning. These two approaches were merged and are depicted in an 'onion diagram' in figure 2A.2. The onion is used more often as a metaphor when examining constructs (26).

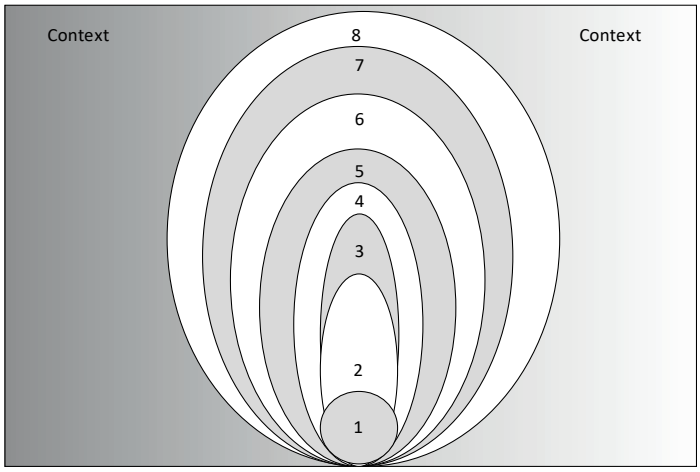

Figure 2A.2. Layers of concept analysis. 1=professional paradigm, 2= theories, 3= intentions, 4= antecedents 5=attributes, 6= outcomes, 7= content.

We propose to use this multi-layered approach to organize and categorize the extensive and diverse data on clinical reasoning of the included studies. The data will be extracted, independently by two reviewers. Our aim with this phase is to get a grip on the data, and to do justice to the rich research on clinical reasoning. The provisional definition of the layers are described in table 2A.1.

1	Professional paradigm	A constellation of shared beliefs, agreements, habits, language and procedures (27, 28)
2	Theories	The used descriptive theories to underpin clinical reasoning
3	Intentions	Reported goals an intentions
4	Antecedents	Events, phenomena, behaviours, conditions or attitudes that occur prior (14)
5	Attributes	Characteristics (14) and techniques (13)
6	Outcomes	Results of clinical reasoning
7	Content	The domain and 'what'
8	Contextual factors	The influences from environment

Table 2A.1. Layers

The layers will be further described in the review report. Our last step is inspired by Cottrell (29), who described simultaneous concept analysis. We plan to present our findings in a 'validity matrix', with a column for nursing and medicine, to make the findings suitable for comparing and contrasting.

Data presentation

The data of previous stages will be presented in tables and figures. All data will be available on request from the first author.

Ethics and dissemination

This study involves no human participants and is based on published studies. As such, ethical approval is not required. Our findings will be disseminated through a publication and through presentations on conferences and will lead to the choices for further studies in the PhD track of the first author (JV).

Implications

To our knowledge, this integrative review on clinical reasoning in the medical and nursing profession will be the first, systematic, study to compare and contrast reasoning of both professions in order to create conceptual clarity. This clarity is needed to optimise interdisciplinary collaboration in patient care, for considering the transferability of study results in another professional domain, and for educators to design training and to guide their

students. The used method to extract and analyse data is new and might inspire other researchers on other, complex topics.

Chapter 2.B.
Reasoning like a doctor or like a nurse? A systematic integrative review

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Abstract

When physicians and nurses are looking at the same patient, they may not see the same picture. If assuming that the clinical reasoning of both professions is alike and ignoring possible differences, aspects essential for care can be overlooked. Understanding the multifaceted concept of clinical reasoning of both professions may provide insight into the nature and purpose of their practices and benefit patient care, education and research.

We aimed to identify, compare and contrast the documented features of clinical reasoning of physicians and nurses through the lens of layered analysis and to conduct a simultaneous concept analysis. The protocol of this systematic integrative review was published doi: 10.1136/bmjopen-2021-049862. A comprehensive search was performed in four databases (PubMed, CINAHL, PsychInfo and Web of Science) from 30th March 2020 to 27th May 2020. 69 Empirical and theoretical journal articles about clinical reasoning of practitioners were included: 27 nursing, 37 medical, and 5 combining both perspectives. Two reviewers screened the identified papers for eligibility and assessed the quality of the methodologically diverse articles. We used an onion model, based on three layers: Philosophy, Principles and Techniques to extract and organize the data. Commonalities and differences were identified on professional paradigms, theories, intentions, content, antecedents, attributes, outcomes and contextual factors. The detected philosophical differences were located on a care-cure and subjective-objective continuum. We observed four principle contrasts: a broad or narrow focus, consideration of the patient as such or of the patient and his relatives, hypotheses to explain or to understand, and argumentation based on causality or association. In the technical layer a difference in the professional concepts of diagnosis and the degree of patient involvement in the reasoning process were perceived.

Clinical reasoning can be analysed by breaking it down into layers, and the onion model resulted in detailed features. Subsequently insight was obtained in the differences between nursing and medical reasoning. The origin of these differences is in the philosophical layer (professional paradigms, intentions). This review can be used as a first step towards gaining a better understanding and collaboration in patient care, education and research across the nursing and medical professions.

Introduction

When physicians and nurses are looking at the same patient, they may not see the same picture (30). If clinicians assume that the clinical reasoning of different professions is alike, they may miss significant aspects and a more comprehensive picture of the patient situation (9, 10, 31). Yazdani and Hoseini Abardeh (4) characterize clinical reasoning as "*a challenging, promising, complex, multidimensional, mostly invisible, and poorly understood process*". Clinical reasoning has been defined and studied 'within' each profession. To date, it is unclear if the content, process, and outcomes are comparable 'between' professions. In this review, we focused on the two largest healthcare disciplines (32), physicians and nurses, to explore this gap in the literature. Ignorance about differences might hamper collaboration in patient care, interprofessional education and even the transferability of research findings. Understanding the clinical reasoning approaches of both professions may provide insight into the nature and purpose of their practices. A common language for clinical reasoning might benefit communication, education, research and patient care (31, 33).

Clinical reasoning is described as a multifaceted concept (5, 34) and as a complex concept for the literature uses many terms, which are either synonyms or related or surrogate terms (1, 5, 11). For the purpose of this paper, we use the definition of Simmons (35), because it is used in medical and nursing literature: clinical reasoning is *"a complex cognitive process that uses formal and informal thinking strategies to gather and analyse patient information, evaluate the significance of this information and weigh alternative actions".* Professionals use clinical reasoning to diagnose and to choose interventions or treatments; they practice either diagnostic or management (therapeutic) reasoning (36-38).

Comparing the clinical reasoning of professionals is challenging. Not only does clinical reasoning take place in the heads of individuals (39), differences have also been identified between novices and experienced and expert professionals (40, 41) and between doctors of different medical disciplines (42). Moreover, the reasoning of professionals seems to adjust to the complexity of each patient's problem (40) and to the current context (43, 44). This flexibility aspect of clinical reasoning leads to a disunited view of the concept of clinical reasoning.

Differences between professions can be explained by their unique professional focus and knowledge, although clinical reasoning is more than operating on a knowledge base (34). Clinical reasoning can be studied from a cognitive, situated, linguistic or social perspective, (11) with the aim to explain either the process of reasoning, the knowledge structures or the cognitive modes (e.g. intuition or analysis) that are used (4). All these aspects have been investigated within the boundaries of the medical or nursing profession. A few studies have been carried out to investigate how both reasoning approaches relate to each other. To our knowledge, no systematic review of similarities and differences in the clinical reasoning of medical and nursing professionals has been published.

To do justice to the multifaceted nature of clinical reasoning, we aimed to compare and contrast 'all' the facets of clinical reasoning in the medical and nursing literature. For this purpose, we adapted and combined the model of layered analysis of educational interventions of Cianciolo and Regehr (13) and the concept analysis of Walker and Avant (14). Our intention was to 'peel the shells of the clinical reasoning onion' in order to make this term accessible for analysis. Through the lens of layers and concepts, we aimed to answer the following research questions: What are the

features of clinical reasoning of professional practitioners as described in medical and nursing scientific literature, and what can we learn about clinical reasoning from this simultaneous concept analysis? Our broader ambition is to improve mutual understanding and collaboration in patient care, education and research by increasing the conceptual transparency of clinical reasoning among nurses and physicians.

Methods

Protocol and registration

The protocol of this systematic integrative review was published in BMJ Open, doi:10.1136/ bmjopen-2021-049862 (24). After this publication, we further refined the layered analysis, which will be explained in the sub-section layers, shells and cells.

Search strategy

We followed the criteria of the PRISMA 2020 statement (25). The search strategy was developed by JV and a clinical librarian (HK) and was carried out from 30 March 2020 to 27 May 2020. We searched in the databases Pubmed, CINAHL, PsychInfo, and Web of Science for methodological diverse articles on the clinical reasoning of nurses, physicians, or both, in all kinds of practice settings and specialties. The full search strategies for all databases are included in appendix 1. Because of the high number of identified articles in this search, we purposefully restricted the sample to records from 2000 to May 2020 (26, 27). The underlying arguments were that from this date clinical reasoning was given a place in the professional competency sets (28-30), and reviews, based on older studies were not excluded in our strategy. To discover other studies relevant to the layers of our research question, we applied ancestry searching by screening the references of included studies (31, 32), also to ascertain that important earlier studies would not be missed.

Study selection

The records were downloaded into Rayyan and Endnote, and duplicates were removed. The titles and abstracts of the records were screened by JV and RK in Rayyan by applying the selection criteria agreed on by the full research team (table 2B.1.). Differences in inclusion and exclusion decisions were discussed until agreement was reached. The full-text publications were loaded into Endnote and selected by one author (JV) (33), based on the established inclusion and exclusion criteria (table 2B.1).

Criteria	Inclusion	Exclusion
Types of publication	Journal publications	Theses, dissertations, books, articles without abstract
Population	physicians, nurses practitioners, professionals	Other health professionals, medical or nursing students, residents, non-practicing physicians or nurses nurse practitioners
Types of research	quantitative, qualitative, empirical, theoretical, expert opinions, reviews	Case studies
Setting	Practice in all healthcare settings	In-school or university, simulation, training
Focus of article	Clinical reasoning, judgment, synonyms of reasoning and judgment, reasoning approaches and processes, comparison, collaboration physicians and nurses, diagnostic uncertainty	Decision making (tools), decision-making analysis, normative approaches, critical thinking, Bayesian thinking, intuition, education, educational interventions, assessment, accuracy of reasoning, moral reasoning
Publication period	Inception-may 2020	Before 2000 and after May 2020

Table 2B.1. Selection criteria

Quality assessment

JV and SS independently appraised the quality of the provisionally included studies with an instrument of Badu et al., (34) which fits methodologically diverse research reports, as described in our protocol. Assessment differences were small and discussed until agreement was reached.

Data extraction and processing in layers, shells and cells

From the included papers, we extracted data according to the planned data items, i.e. the layers of clinical reasoning, which are summarized in table 2B.2.

We used the three layers identified by Cianciolo and Regehr (22), philosophy, principles and techniques. These layers have blurry boundaries. Besides, the layers differ in their sensitivity to change under variable circumstances. The core layer, philosophy, includes underlying intentions, essence and philosophies. To capture this layer, we searched for three types of data (text fragments or purports): professional paradigms, underpinning theories, and intentions or goals of clinical reasoning. Under the middle layer, principles, we grouped another three dimensions of clinical reasoning: the content, the antecedents and the attributes; together, they reflect the structural aspects of clinical reasoning. Although the attributes also represent the techniques of reasoning, we added the attributes in the layer of principles under the assumption that they are less sensitive to

change than the last two shells of the techniques layer: outcomes of reasoning and contextual factors. Under the shells, the data were clustered into cells.

JV and SS independently extracted the data from 5 studies, randomly chosen, to improve delineation of the layers and shells by discussing the (minor) differences. JV extracted the rest of the data into validity matrices (35), one for each shell, with columns for nursing and medicine, and clustered them into cells, i.e. categories of data elements. These data elements were the fourth tier of our data collection. The validity matrices were discussed in the full research team in several rounds of summarizing and reduction, to manage the large amount of data.

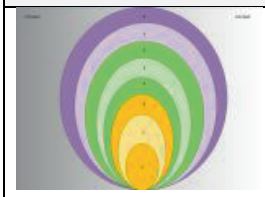
Onion	Layers	Onion shells	Description
	Techniques	Contextual factors (8)	Non-medical factors that influence the reasoning process and outcomes, such as characteristics of patients, health care systems and environment
		Outcomes (7)	Results of clinical reasoning, events that occur as a result of a concept, also referred to as consequences
	Principles	Attributes (6)	The defining characteristics of a phenomenon, the core of a concept analysis; we used the categories of attributes of Cote (45) to define the cells of this shell
		Antecedents (5)	Events, phenomena, behaviours, conditions or attitudes that precede clinical reasoning
	Philosophy	Intentions (3)	Information about goals which can describe reasoning as an entity with a stable identity or essence, even when adapted to other circumstances
		Theories (2)	Internally consistent groups of relational statements about a phenomenon that are used to describe, explain or prescribe clinical reasoning. Guided by our research question, we limited ourselves to data about descriptive theories which indicate how professionals actually reason
		Professional paradigm (1)	A constellation of shared beliefs, agreements, habits, language, and procedures. These perceptions and expectations are the essence which goes beyond all other findings of clinical reasoning.

Table 2B.2. Layers and shells of clinical reasoning

Patient and public involvement

Patients, students and educators were included in this review only through inclusion of what was written about them in the published reports.

Results

Study selection

The search of four databases for papers about the clinical reasoning of physicians and nurses identified 5718 unique records. Based on the screening of titles and abstracts with our selection criteria, we reviewed 125 full text reports, 55 of which were excluded because they did not fit the selection criteria. Eight papers were excluded during quality assessment (JV, SS) because of missing research questions or aims. Of the 24 records identified through ancestry searching, we included 7 – mostly published before 2000- because of their relevance to one or more layers. The study selection is summarized in figure 2B.1.

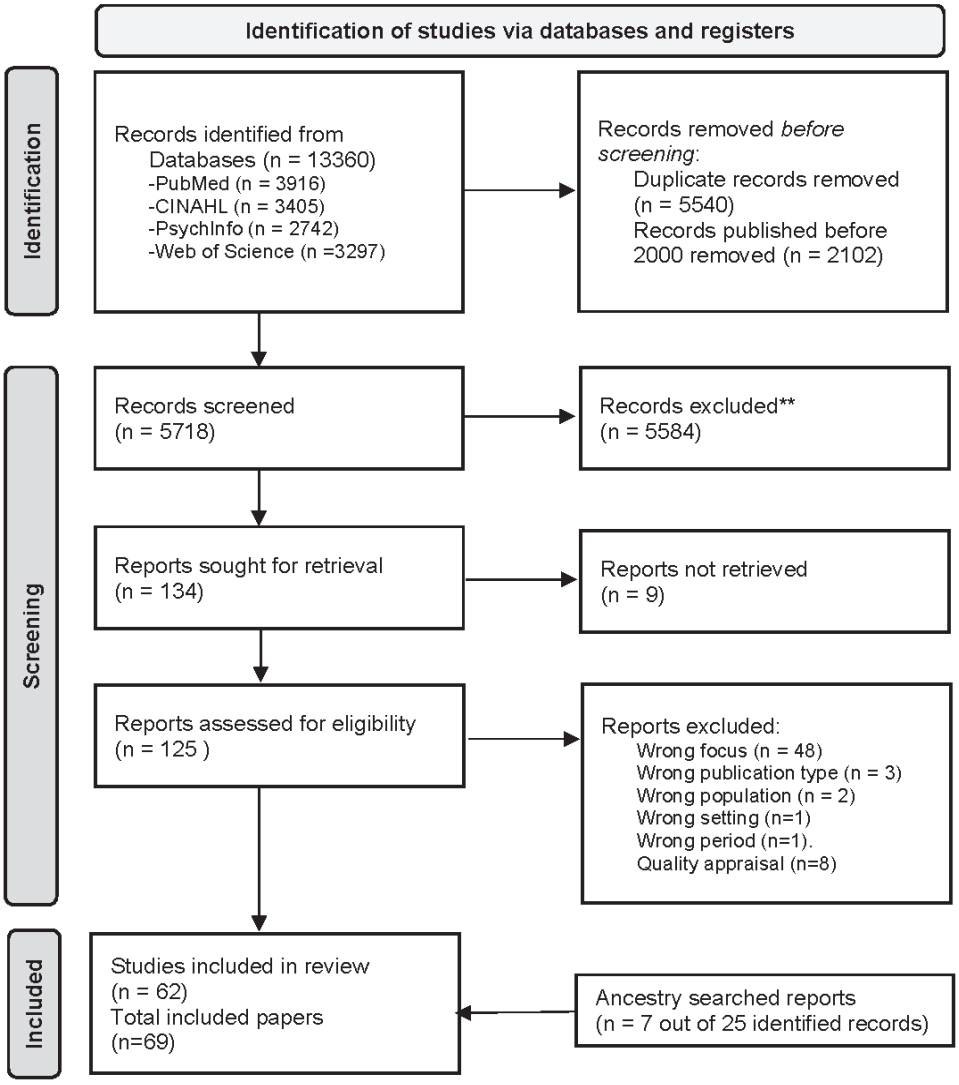


Figure 2B.1.

Preferred reporting Items for Systematic reviews and Meta Analyses (PRISMA) 2020 Flow diagram (46)

Study characteristics

Of the selected reports, 27 studies reported on nursing research, 37 on medical research and five studies combined nursing and medical perspectives. The included reports used diverse methods: empirical and secondary studies, qualitative and quantitative studies, systematic reviews, concept analyses and expert opinions. The selected studies, their study types and quality assessment ratings are presented in table 2B.3.

References	Type of study	Quality assessment	Profession
Adams, Goyder (47)	qualitative	88%	M
Alam, Cheraghi-Sohi (48)	systematic review	91%	M
Austgard (49)	text, opinion, review	93%	N
Balla, Heneghan (50)	qualitative	75%	M
Banning (51)	text, opinion, review	93%	N
Benbassat (52)	text, opinion, review	ancestry searched	M
Bissessur, Geijteman (37)	text, opinion, review	100%	M
Blondon, Maitre (53)	mixed methods	92%	MN
Bonilauri Ferreira, Ferreira (54)	qualitative	82%	M
Buckingham and Adams (55)	text, opinion, review	100%	N
Cader, Campbell and Watson (56)	text, opinion, review	93%	N
Cappelletti, Engel and Prentice (57)	systematic review	85%	N
Charlin, Lubarsky (58)	qualitative	ancestry searched	M
Charlin, Tardif and Boshuizen (59)	text, opinion, review	100%	M
Chiffi and Zanotti (12)	text, opinion, review	93%	MN
Cote and St-Cyr Tribble (45)	text, opinion, review	80%	N
Cox (60)	text, opinion, review	100%	M
Crook (61)	text, opinion, review	100%	N
Croskerry (62)	text, opinion, review	100%	M
Crow, Chase and Lamond (63)	text, opinion, review	ancestry searched	N
Davis (64)	text, opinion, review	ancestry searched	M
Dumas, Torre and Durning (65)	text, opinion, review	100%	M
Durning, Artino (66)	mixed methods	75%	M
Durning, Artino (67)	text, opinion, review	100%	M
Edwards, Sadoski and Burdenski (68)	quantitative, non-randomized	88%	M

References	Type of study	Quality assessment	Profession
Elstein and Schwarz (69)	text, opinion, review	100%	M
Evans and Trotter (70)	quantitative, non-randomized	ancestry searched	M
Fawcett, McDowell and Newman (71)	text, opinion, review	100%	N
Franco, Bouma and Bronswijk (27)	text, opinion, review	ancestry searched	M
Goldszmidt, Minda and Bordage (72)	quantitative, descriptive	100%	M
Groves, O'Rourke (73)	quantitative, non-randomized	78%	M
Gupta, Potter and Goyer (74)	text, opinion, review	100%	M
Holder (7)	systematic review	62%	N
Johnsen, Slettebo and Fossum (75)	qualitative	82%	N
Judd (76)	text, opinion, review	100%	N
Juma and Goldszmidt (77)	qualitative	75%	M
Kiesewetter, Fischer and Fischer (78)	systematic review	78%	M
Lee, Lee (79)	qualitative	75%	N
Lee, Chan and Phillips (80)	text, opinion, review	100%	N
Levett-Jones, Hoffman (81)	text, opinion, review	100%	N
Loftus (82)	text, opinion, review	100%	M
Malterud (83)	text, opinion, review	100%	M
Malterud, Reventlow and Guassora (84)	qualitative	87%	M
Marcum (85)	text, opinion, review	100%	M
McLean (86)	qualitative	100%	MN
Mirza, Akhtar-Danesh (87)	text, opinion, review	100%	N
Norman (88)	text, opinion, review	100%	M
Norman, Young and Brooks (89)	text, opinion, review	100%	M
Passos Vaz da Costa and Barros Araújo Luz (90)	text, opinion, review	100%	N

References	Type of study	Quality assessment	Profession
Pelaccia, Tardif (91)	qualitative	82%	M
Pelaccia, Plotnick (92)	text, opinion, review	100%	M
Pomeroy and Cant (93)	mixed methods	68%	M
Pottier and Planchon (3)	text, opinion, review	100%	M
Psiuk (94)	text, opinion, review	ancestry searched	N
Quaresma, Modernel Xavier and Cezar-Vaz (95)	text, opinion, review	100%	N
Round (96)	text, opinion, review	93%	M
Salantera, Eriksson (97)	quantitative, non-randomized	95%	MN
Shin (98)	text, opinion, review	100%	M
Simmons (35)	text, opinion, review	100%	N
Simmons, Lanuza (99)	qualitative	82%	N
Stolper, Van de Wiel (100)	text, opinion, review	100%	M
Tanner (101)	text, opinion, review	100%	N
Taylor (102)	qualitative	82%	MN
Twycross and Powls (103)	qualitative	82%	N
van Graan, Williams and Koen (104)	text, opinion, review	100%	N
Victor-Chmil (6)	text, opinion, review	100%	N
Yang, Thompson and Bland (105)	quantitative, non-randomized	82%	N
Yazdani, Hosseinzadeh and Hosseini (106)	text, opinion, review	100%	M
Καρρά, Καλαφάτη (107)	qualitative	88%	N

Table 2B.3. Included studies. M=medical, N=nursing, MN=both professions

The layered data analysis: shells, cells and data elements

We arranged all our findings (data elements or quotes) in validity matrices, clustered in shells and cells, as shown in appendix 3. A rough overview of commonalities and dissimilarities found in our layered analysis is depicted in figure 2B.2.

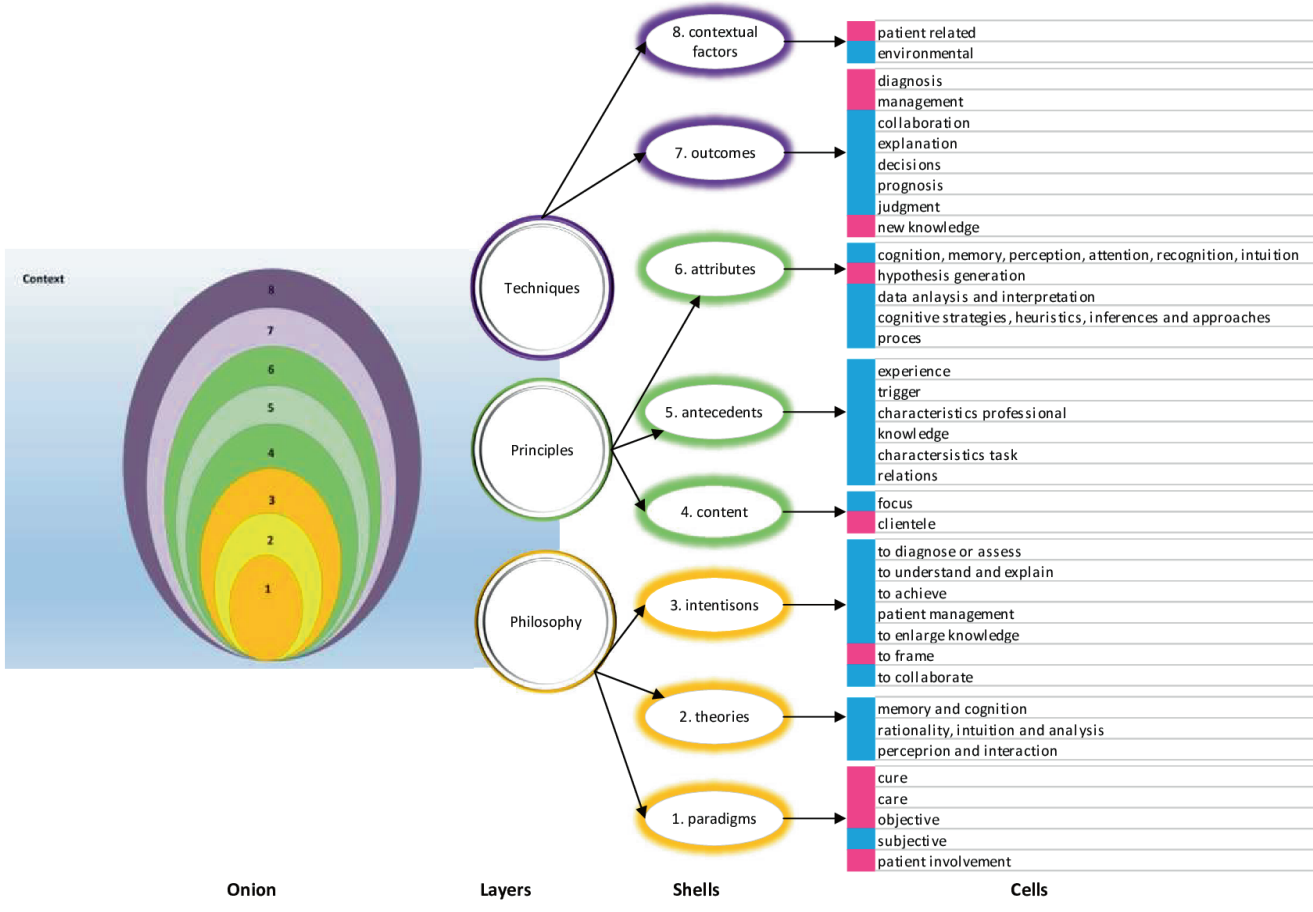


Figure 2B.2. Overview of commonalities and dissimilarities found in the layers, shells and cells. Three layers (purple, yellow, green), eight shells, made up of cells. The cells marked in blue represent commonalities, the cells marked in pink show dissimilarities in reasoning

1. Philosophy: paradigms

We classified the extracted data on paradigms into five cells. In the studies included, the nursing and medical paradigms differ. The medical articles focused on the medical (curing) paradigm of diagnosis and treatment (27), while the nursing articles focused on a pragmatic paradigm with encompassed caring (61, 87). However, nursing studies also reported on nurses who play a role in diagnosis and treatment (53), while in medical literature, clinical care and a functional health paradigm are mentioned as well (27, 74). Based on the literature, care as well as cure seems to be given attention by both professions, while the emphasis on either may differ. On an objective–subjective continuum, nurses and physicians both recognize subjectivity in their task perceptions, but they differ in their appreciation of objective 'knowing' and in the degree to which they find it important. Medicine is often based on empirical knowledge, abstracted from the context and the patient (83), while nursing care is better described using a holistic view on the individual patient (49, 61, 80). By aggregating the data, we suggest that these differences as well as commonalities to be viewed on continuums, a care-cure continuum and a subjective-objective continuum. The latter is substantiated in the most noticeable documented difference: in nursing, a patient is involved in clinical reasoning, while in medicine, this is not necessary (49, 52, 80).

2. Philosophy: theories

We found three types of theories in both nursing literature and medical literature: on memory and cognition, on rationality, analysis and intuition, and on perception and interaction. The following theories are prominent examples of these three types of theories:

- Information processing theories that aim to explain how perceived information is related to knowledge, knowledge storage and retrieval from memory (108)
- Theories on analytic, conscious, slow, intuitive, implicit or fast thinking, either viewed as a dual process or on a continuum, based on the characteristics of the task (40)
- Situativity theory includes context and experience to explain thinking, learning and knowledge (109)

In medical literature, more theories are used to explain contextual influences, perception and interaction in particular, than in nursing reports.

3. Philosophy: intentions

The intentions of clinical reasoning seem to be shared to a large extent by physicians and nurses. We categorized the data into seven cells: to diagnose or assess, for patient management (e.g. to decide on a plan of actions), to understand and explain, to enlarge knowledge, to collaborate, to achieve and to frame (appendix 3, figure 2B.2.). The differences observed at the cell level were related to the degree of autonomy or initiative: to establish (physician) or to recognize (nurse), to manage (physician) or to reduce (nurse), and to frame an encounter (physician). Moreover, physicians aim to diagnose and plan treatments, while nurses aim to reconstruct their understanding of the problems in a constantly changing situation (63, 97) and to understand symptoms and their impact on the patient (53, 75).

4. Principles: content

Much of the content of clinical reasoning is similar for physicians and nurses. However, physicians have a narrower focus, which is on the illness and its causes, while nurses have a broader

focus, which is on the content or domain of their care. Besides feeling responsible for illness and health, nurses also feel responsible for the consequences of the patients' health problems. It is a matter of the 'sickness' or the 'sick person'. Nonetheless, also in medicine, in acute situations, management of the patient's condition precedes diagnosis of the disease (92). Bonilauri et al. found that physicians rely more on patient-specific heuristics than on disease-specific clinical guidelines (54). The most prominent difference is that physicians focus on an individual patient as the object of reasoning and that nurses may include the nearest and the dearest (the relatives) and even a patient's community (12, 71, 97, 101).

5. Principles: antecedents

We grouped the aspects preceding clinical reasoning into professional experience, knowledge, triggers, task characteristics, a professional's characteristics, and relations (appendix 3, figure 2B.2). Knowledge and experience are shared prerequisites of reasoning, although there is a difference between the topics of formal knowledge. Nurses tend to use more experiential knowledge, whereas physicians tend to use more theoretical knowledge (97). Concerning the triggers and task characteristics, nurses have a broader view ('life situation' versus 'illness'). Physicians are triggered by contextual data, such as how a patient arrives at the Emergency Room (91). Nurses, alternatively, are triggered by the patient's needs, for example "*I could see today that she is low, she looked tired and things are telling on her"* (44). Diagnostic uncertainty has been identified as a trigger for further reasoning for physicians (47), but is not mentioned in the selected nursing articles.

6. Principles: attributes

The findings on attributes of clinical reasoning are clustered into 5 groups (appendix 3, figure 2B.2.). Many attributes are shared between physicians and nurses, e.g., they act quite alike in the use of cognition. Differences are found in hypothesis formulation. Nurses' hypotheses are aimed to explain or understand patient symptoms and often lack causality or predictive power. For example, nurses associate nausea with a medical treatment, they do not use physiological arguments. In medicine, a hypothesis can be justified by cause-and-effect arguments (12, 61). Analytic strategies for hypothesizing, which are often used by physicians, can be abstract and decontextualized (74), whereas we could not find these strategies in the nursing literature. Nurses use analytic strategies to classify and to link cues to categories (51, 55, 75, 99).

7. Techniques: outcomes

For both physicians and nurses, clinical reasoning leads to diagnosis, judgments, decisions, management plans, prognosis, explanations, collaboration and new knowledge. However, nursing diagnoses differ from medical diagnoses. The aim of a nursing diagnosis is to identify the current situation, the responses to health problems of a patient and his relatives (63, 90). Since these responses or situations are variable, nursing diagnosis is an ongoing process to detect changes in the patient's condition. By contrast, a medical diagnosis is made at a discrete time point and is relatively stable (63). According to Chiffi and Zanotti (12), the purpose of a medical diagnosis is to identify biological alterations, organic or functional, while for nurses it is to identify possibilities to enhance self-care. The importance of causality is more prominent in a medical diagnosis, while nursing diagnoses are often descriptive generalizations which are associated with a health problem. A medical diagnosis can be established without direct involvement of the patient, while this is often

not possible in nursing, where the patient's (or his or her relative's) perception of their condition and their level of self-care are indispensable factors in formulating a diagnosis (12, 49). While patient management is a shared outcome, the physician designs the treatment plan that fits with the illness, while the nurse designs the care plan and chooses actions that fit with the patient's condition, the medical treatment plan and the patient's self-care goals. The two plans come together in the evaluation of parameters, of 'the look´ of the patient, and of the progress that has been achieved (102).

8. Techniques: contextual factors

The influence of environmental factors on clinical reasoning has been described in many nursing and medical articles (35, 61, 62, 66, 78, 92, 101). Some authors mentioned the characteristics of the professionals as contextual factors, whereas we chose to regard them as antecedents of clinical reasoning. The included reports differed in the labeling of patient-related factors. For instance, in studies on the clinical reasoning of physicians, they were regarded as contextual factors, whereas studies on the clinical reasoning of nurses regarded patient-related factors as part of the problem., This difference in labelling is related to our findings about paradigm, content, and outcomes, which indicated that nurses give their patients a different role in the reasoning process than physicians.

Discussion

In this systematic integrative review, we aimed to provide an overview of the commonalities and differences in the clinical reasoning of physicians and nurses by scrutinizing the data of the included studies with a detailed layered analysis, which resulted in our onion model. By breaking down the concept of clinical reasoning into layers, shells and cells, we were able to provide insight into these differences and commonalities. By comparing multiple facets of the clinical reasoning of these two professions, the content of clinical reasoning and the contrasts between medicine and nursing became clearer.

The main differences were found in the philosophical layer, where nurses and physicians were shown to have dissimilar professional paradigms considering the two continuums care-cure and objectivity-subjectivity and considering patient involvement, and where they used different professional expressions indicating more or less autonomy and more or less initiative. In the layer of principles, our results revealed four contrasts: a broader versus a narrower focus, consideration of the patient alone versus consideration of the patient and his relatives, the use of hypotheses for scientific explanation versus for holistic understanding, and argumentation based on causality versus argumentation based on association. The most notable differences between nurses' and physicians' clinical reasoning are the dissimilar concepts of diagnosis and the different usage of patient factors in the reasoning approach.

According to Chiffi and Zanotti (12) and Twycross and Powls (103), nurses need to know their patients and use their involvement to be able to reason about the required care. However, based on research on illness scripts (110, 111) we assume that the reasoning of nurses can also be triggered before patient acquaintance.

Part of the identified dissimilarities between the clinical reasoning of physicians and nurses can probably be explained by the fact that the majority of the records on medical clinical reasoning

focused on diagnostic reasoning. If we compare our findings of nurses' clinical reasoning with the characteristics of medical management reasoning or therapeutic reasoning, the differences become smaller. Compared to diagnostic reasoning, less is written about management reasoning of physicians. However, in patient care, management reasoning might be more relevant than diagnostic reasoning (36, 112). In management reasoning, the patients and their preferences are involved, the broader care situation is included, and ongoing monitoring and adjustment is required. While a diagnosis can be right or wrong, a management plan is chosen out of many options to fit the patient, the situation and the practitioner. Hence management reasoning, like nursing reasoning, is all about the dynamics, in time, between the players and the field.

A second finding is that most of the included studies focused on processes within individuals. Clinical reasoning is often described in terms of its attributes like cognition, memory, formal analysis or intuition or in terms of the antecedents of knowledge and experience. These features are at the heart of the literature on clinical reasoning, and they mainly refer to individual processes. The process and content of clinical reasoning can vary between individuals (93) because individual experience may have more influence than training (92), and because a form of reasoning is used that fits the situation (51). The reasoning of professionals is also changeable due to time aspects. Professionals look at the present to identify events, at the past to identify causes and at the future to reason about prognoses and therapy (physicians and nurses) or about the patient's future functioning (nurses) (12). The focus over the years on individual clinical reasoning aspects might have been chosen due to the complexity and multi-dimensionality of clinical reasoning (1). Moreover, this focus could be a result of the history of research on clinical reasoning on individual process, from problem solving to memory and mental representations, to the role of science and studies about non-analytic and analytic thinking (4, 88).

However, more importantly, in practice, the care of a patient usually involves more than one professional (78). In the context of interprofessional collaboration, more attention has been paid to the situative context of reasoning than to the individual processes. Terms like collaborative reasoning (53, 78) or ecological reasoning (113) are used to describe the sociological, environmental and team aspects of and influences on reasoning. Reasoning can be seen as a collaborative process (3, 53) and feedback is considered essential (50), as contradicting information from colleagues triggers further clinical reasoning (51, 54, 84). The existing differences between the reasoning of nurses and physicians can then be viewed as necessary and complementary (97). If both reasoning approaches are articulated and shared, the reasoning itself could be improved via debate (55, 78, 84), which can lead to an improved and more holistic picture of the patient (10, 53).

Education, research and communication about clinical reasoning is complicated because of the 'polyphony' in the terms, definitions and conceptualisations of clinical reasoning (1, 11, 39). With our findings on clinical reasoning, we can argue that it is worthwhile to pay attention to the layers, the onion shells and cells that make up the concept, and not to focus on clinical reasoning as a indivisible construct.

Strengths and limitations

The stepwise approach, grounded in guidelines and theoretical frameworks of layered analysis and concept analysis was developed to diminish bias and improve rigor. The extracted data were repeatedly discussed in the full research team to reach data reduction and organization and to debate the main differences. This approach might enhance the confidence in our findings. The use of an onion model to investigate and analyse a complex cognitive process increases the transparency of our results. An evident limitation of our study on the differences between the clinical reasoning of nurses and physicians is that we investigated what was written about their clinical reasoning in journal articles. We excluded oral reports or case studies, which may have told different, personal stories about clinical reasoning. We deliberately chose to use articles published in peer-reviewed journals because we assumed that they adequately reflect the current, depersonalized knowledge about clinical reasoning. The second limitation is inherent in the chosen method of an integrative review of methodologically diverse, empirical and theoretical articles. Since we did not aim to evaluate evidence but to reach a more comprehensive understanding, we did not weigh data according to their evidential value but to their informational value. The third limitation is that we did not take cultural aspects into account. We did not exclude reports in languages other than English, but most of the included articles were written by European and North American researchers. Moreover, we did not check our findings for potential differences in the culture of hospitals, psychiatric institutions or home care, which could be considerable. These differences might be explored in future research. Finally, we limited our search to studies on clinical reasoning that were published in the last 20 years. However, in this subset, we did not place our findings on a chronological timeline to investigate changes in reasoning of physicians and nurses, which could also be a topic for future research.

Recommendations

Clinical reasoning is a multifaceted container concept. Our findings of the differences in facets of clinical reasoning, modelled in the onion, can be used in interprofessional teams in the clinics, as well as in clinical reasoning training programs for nurses and physicians, in interprofessional education and in research. If researchers or policy makers of one profession consider using the results of studies on the clinical reasoning of another profession, we recommend to not only check the used terms or definitions, but also to check the three layers philosophy, principles and techniques in order to decide if the evidence is meaningful for their research question.

Multidisciplinary collaboration can be improved based on the realization that differences in reasoning between professionals are facets of a shared concept (55). Like Salantera et al., (97), we assume that the differences in reasoning described in our study must be cherished, since they may add value to patient care and to collaboration. Moreover, training professional nurses and physicians in understanding each other's reasoning approach might contribute to better patient care.

Conclusions

We learned from the simultaneous analysis of clinical reasoning, that this complex and multidimensional concept can actually be analysed by breaking it down into layers. With our onion model of shells, cells and data elements, we could identify the detailed features of clinical reasoning. Subsequently insight was obtained in the commonalities and differences in the reasoning of nurses and physicians. The origin of the differences is in the philosophical layer -professional paradigms and intentions-, which is in line with the model of layered analysis. The results of this review can be used as a first step towards gaining a better understanding and collaboration in patient care, education and research across the nursing and medical professions.

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Shaping clinical reasoning

Chapter 3
Illness scripts in nursing: Directed content analysis

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Abstract

Aims: To explore the possible extension of the illness script theory used in medicine to the nursing context.

Design: A qualitative interview study.

Methods: The study was conducted between September 2019 and March 2020. Expert nurses were asked to think aloud about 20 patient problems in nursing. A directed content analysis approach including quantitative data processing was used to analyse the transcribed data.

Results: Through the analysis of 3912 statements, scripts were identified and a nursing script model is proposed; the medical illness script, including *enabling conditions*, *fault* and *consequences,* is extended with *management, boundary, impact, occurrence,* and *explicative statements.* Nurses often used *explicative statements* when pathophysiological causes are absent or unknown. To explore the applicability of Illness script theory we analysed scripts' richness and maturity with descriptive statistics. Expert nurses, like medical experts, had rich knowledge of *consequences, explicative statements* and *management* of familiar patient problems.

Conclusion: The knowledge of expert nurses about patient problems can be described in scripts; the components of medical illness scripts are also relevant in nursing. We propose to extend the original illness script concept with *management*, *explicative statements*, *boundary*, *impact and occurrence,* to enlarge the applicability of illness scripts in the nursing domain.

Impact: Illness scripts guide clinical reasoning in patient care. Insights into illness scripts of nursing experts is a necessary first step to develop goals or guidelines for student nurses' development of clinical reasoning. It might lay the groundwork for future educational strategies.

Introduction

The optimal strategies for fostering the development of nursing students' clinical reasoning in the academy or in clinical placements still seem unclear (1, 2). Nurses are increasingly called upon to make rapid judgements under conditions of uncertainty due to the rise in acute hospitalised, chronically ill and elderly patients. In addition, lengths of stay have decreased, while patients suffer from more complex problems, with the accompanying risk of serious deterioration (3-6). Holder (7) states that flawed reasoning leads to flawed care. For these reasons, considerable attention is paid in clinical placements to preparing nursing students for clinical reasoning. Reasoning in real-life practice may be influenced by issues related to the individual student, the reasoning task and clinical teaching.

In spite of all the research on clinical reasoning, important questions about educational strategies and the development of clinical reasoning in nursing students during clinical placements still lack evidence-based answers (8, 9). In medical education research, illness script theory provides a possible framework for the development of reasoning skills. This theory is based on information processing and memory organisation; people tend to organise repeated experiences and connect perceptions if they seem related or happen simultaneously in schemes or scripts (7, 10). Whether and how illness script theory is applicable to nursing is unknown. In this study, we explore the potential of illness script theory for nursing, as it might consequently offer a potential scientific basis for designing teaching methods for clinical reasoning.

Background

Nurses' clinical reasoning can be described as "a complex process that uses cognition, metacognition and discipline-specific knowledge to gather and analyse patient information, evaluate its significance and weigh alternative actions" (11). Clinical reasoning, in nursing, as in other health professions, is context-dependent and domain-specific and reflects scientific and clinical knowledge (11-15).

Illness script theory proposes that experts' reasoning is guided by knowledge structures in the memory (scripts), which explains why medical experts are able to quickly interpret complex situations and predict how they might evolve (10, 16, 17). The theory states that illness scripts develop through experience with real patients (16), which explains changes in memory performance, information processing, decision-making and the decreasing use of biomedical knowledge in growing expertise (10, 18). Illness scripts play a role in recognising, comparing, contrasting and predicting the course of a disease (17).This theory has been applied in medical and advanced nursing education, in classroom and clinical settings (17, 19-21).

Illness scripts have been studied as a possible explanation for professional development and as a concept (22). As a concept, an illness script is a specific script based on patient encounters, representing clinical knowledge in three components. The original illness script components are as follows:

- *Enabling conditions*: patient features like age or occupation and epidemiological factors that influence the probability of a disease;
- *Fault*: the causal pathophysiological process and disturbed body functions;
- *Consequences*: signs and symptoms; the results of a fault (Figure 3.1.) (10, 23, 24).

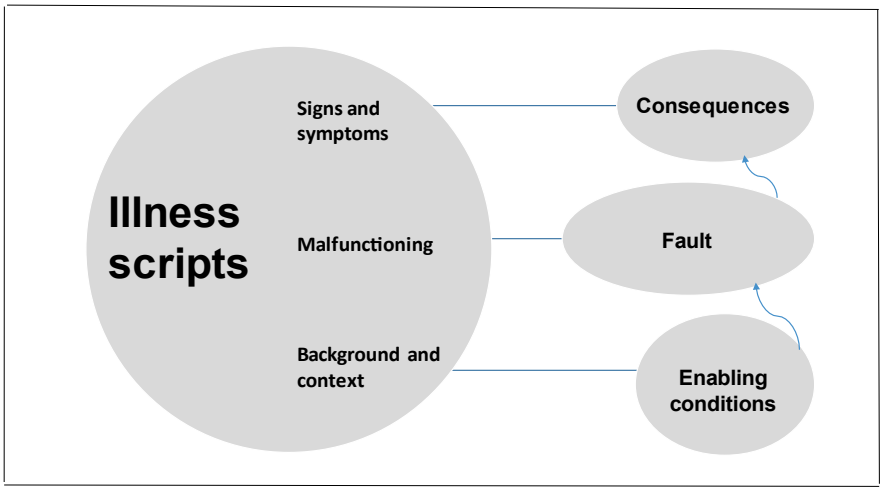

Figure 3.1. Original structure of illness script (based on Feltovich and Barrows (23)

The illness script components have been expanded over the years by researchers to include, e.g. management, environment and a miscellaneous category to improve the fit with actual clinical practice (18, 24, 25). Strasser and Gruber (26) investigated script formation of mental health counsellors. In this field, *fault* knowledge is most often not causal or related to body functions. Hence, Strasser and Gruber split the *fault* component into *theoretical concepts* (theory-based statements) and *explicative statements*, statements that define and explain a problem.

These previous studies have raised questions about how nurses' clinical knowledge is structured and stored. Therefore, our research question was: *How well does illness script theory describe nurses' experience-based knowledge?* Clarity about the concept of illness scripts in expert nurses is a necessary first step to develop goals or guidelines for student nurses' development of clinical reasoning. It might lay the groundwork for future educational strategies.

The study

Aims

This study aims to explore the possible extension of the illness script theory used in medicine to the nursing context. We hypothesise that the knowledge of nurses with experience and know-how, grounded in retrieved patient encounters, can be described by

script-like structures and that the components of nurses' scripts are analogous to the medical illness scripts, including *enabling conditions*, *consequences*, *patient management* and *fault.*

Design

The chosen methods are based on the studies of Custers et al. (1998) and Strasser and Gruber (26), who investigated illness scripts of physicians and counsellors. Likewise, we conducted a qualitative, interview study to provide for think-aloud protocols, which are analysed with deductive directed content analysis (27, 28). The purpose of the method of directed content analysis is to validate or extend a theory or framework (27). This method stems from a naturalistic paradigm and allows for coding interview data from think-aloud protocols and transforming qualitative data into descriptive quantitative data to find supporting or non-supporting evidence for illness script theory in nursing (27, 29). The think-aloud method is selected as a proven effective approach to verbalise cognitive processes like knowledge; it provides rich data related to participants' clinical reasoning (30, 31). We decided to investigate our research question among expert nurses because of their greater understanding of clinical situations and patient responses (30, 31).

Sample/participants

The setting of this research was a large academic hospital (Amsterdam UMC) in The Netherlands. We recruited expert critical care and oncology/haematology nurses from adult intensive care units and oncology/haematology wards with post-graduate specialty qualifications. Based on the unit managers' selections and recommendations (years of experience in the unit), we approached 18 purposefully sampled nurses with more than 10 years' experience as a specialised nurse by email to invite them to participate in our study. With their education and experience, we consider them as experts.

Data collection

Materials

To acquire a list of general, relevant and prevalent patient problems (PPs) in nursing, we selected 20 problems from the Dutch nursing patient problem list, which were identified by nurses in 2012 (32). The 20 PPs represent the 4 areas of human functioning: physical, psychological, social and functional. We added two multi-disciplinary problems (shock and serious adverse events) because of the hospital setting (Figure 3.2) (32-34).

Psychological	Physical
Agitation	Fever
Fear	Pain
Coping, inadequate	Serious adverse event
Mourning	Shock
Consciousness, reduced	Fatigue
Addiction	Wound healing, disturbed
Memory, impaired	Fluid shortage
Mobility, impaired	Loneliness
Sleep pattern, disturbed	Social network, impaired
	Participation problems
	Caregivers, strained
Functional	**Social**

Figure 3.2. Selected patient problems

Procedures

The PPs were presented in a PowerPoint presentation in random order to the participants to avoid the order effect. We piloted the presentation and the main question in one interview, and no changes were made thereafter. The interviewer (main researcher) is a specialised neurology nurse, nurse educator and epidemiologist trained in interview techniques, who is known to some participants but held no professional relationships with them at the time. The presentation opened with a worked-out think-aloud example about nausea to explain the requested task. The interviewer asked the participants to sequentially work on the 20 different PPs in individual interview sessions of 30 minutes maximum. The participants were encouraged to tell all they knew about each problem and patients with these problems. The main question was "What can you tell me about a patient with …" The interviewer encouraged the nurses to elaborate on what they usually observe, do, expect and think with probing questions like "What do you see?" or "How do you notice it?" We were interested in the type of information nurses have stored in memory, not in accuracy or comprehensiveness. The interviews, which took place between September 2019 and March 2020, were audio-recorded and transcribed verbatim.

Ethical considerations

The study was deemed exempt from approval by the Medical Ethical Review Board of an academic hospital. The nurses were invited to participate on a voluntary basis, and informed about the study background by the interviewer, and they signed an informed consent letter. The participants were advised that they could withdraw from the study at any time. All transcripts were anonymised before analysis. Permission to store and process the study data was obtained from the hospital.

Data analysis

Directed content analysis is a highly structured, theory-based process of deductive coding and analysing (interview) data. The think-aloud protocols were segmented into statements, these are units with relevant (nursing) information (18). Using ATLAS.ti, the first author coded the statements into a category system adapted from Custers et al. (18) (Figure 1). The intended categories or codes derived from this reference were *fault*, *enabling conditions* and *consequences*. We extended this original category system with the code *management* (25, 35), with the assumption that also for nurses management knowledge is part of their expertise. Like Strasser and Gruber (2015) and with the same assumption that not all PPs can be related to causal, bio-physical knowledge, we added *explicative statement* to the category system. *Explicative statements* and *fault* together explain or express an understanding of a PP's origin. Statements that could not be categorised according to this model were clustered and open coded. The frequencies of statements per illness script component were calculated in Excel, along with the number of statements per problem and script component.

Rigour

The first author has had prolonged engagement with hospital nurses and the language they use, which ensures the study's credibility. The transcribed statements were read and re-read before coding in several rounds. To ensure confirmability, 2 randomly selected transcribed interviews were coded independently (DD and JV) (25, 36, 37). Differences in coding decisions of the 2 researchers were discussed to define the codes and adjust the coding decisions. We defined the study sample as expert nurses (with a specialised qualification and > 10 years of experience) to enhance transferability. Our data's dependability is reinforced by the 20 different PPs, and confirmability is assured by comparing the codes to earlier studies and the literature. The data were finalised through consensus after discussion in the full research team. All audio recordings, transcripts and coding decisions were recorded in a coding log and ATLAS.ti (38, 39).

Findings

Qualitative

Seven nurses from oncology/haematology units and six nurses from intensive and medium care units participated; all were trained as specialised nurses and had over 10 years' work experience in their units. Due to the COVID-19 crisis, the last two planned interviews were cancelled, one nurse withdrew due to illness and two did not reply. All nurses talked extensively about the 20 PPs during the interviews. The think-aloud protocols of 13 interviews were transcribed and segmented into statements and coded into the above-mentioned category system.

Not all statements could be coded in these five categories. We decided to include in the *management* category statements about plans for additional tests, interviews and observations. Additionally, we clustered the remaining quotes into three extra categories:

impact, *boundary* and *occurrence*. Table 3.1. lists the results of this coding procedure with characteristic quotes and references to previous studies.

Category	Origin	Reference	Description	Quotes
Fault	Original model	(10, 18, 23)	Statements about the causes of the problem, the pathophysiological processes, anatomy or behaviour	*"hypernatremia" (L)* *"allergic reaction to any medicament" (N)*
Consequences	Original model	(10, 18, 23)	Statements about key features of a problem, signs and symptoms, test results and scores	*"Responds very slowly" (K)* *"That your metabolic is completely disrupted"(N)*
Enabling conditions	Original model	(10, 18, 24)	Statements about patient background information like age, gender, the context and epidemiological aspects like exposure or risk factors that influence the probability of a problem	*"I recently cared for a young woman"(E)* *"Often in ENT patients"(F)*
Explicative statement	Extended model	(26)	Statements about factors that explain or can be associated with the problem. The problem "can be traced back to"	*"When the pain is not under control, people are less mobile" (J)* *"And it is a fact that if you start giving chemo the wound, the healing is bad" (I)*
Management	Extended model	(25, 35)	Statements about treatment or intervention plans and decisions, expressions of planning additional tests, interviews or observations	*"Always encourage getting out of bed"(M)* *"You will check the short-term memory"(B)*
Boundaries	Open coding	(14, 40)	Statements about the boundaries of the domain of nursing actions and expertise	*"And I see my role not so much to solve it, but to pass it on to the people who have the expertise"(C)* *"you make that plan together with the doctors"(D)*
Impact	Open coding	Impact (41, 42) Engagement (43)	Statements about how the patient or the nurse are affected by the symptoms or the problem	*"therefore a much longer rehabilitation time if someone is in pain, he is obstructed in carrying out all activities" (B)* *"So that was very difficult to deal with as a team"(G)*
Occurrence	Open coding	(24)	Statements about how common a problem is	*"we see a lot of sad people" (J)* *"in theory they have no wounds here" (H)*

Table 3.1. Codes, descriptions, references and participants' quotes (participants B-N)

The three new components were based on the participants' verbalised experiences. The nurses described the influences of problems on patients' lives and how problems affected themselves as caregivers (impact). They discussed their daily practice in multidisciplinary teams and the necessity to consult other team members (boundary) to provide optimal patient care. The nurses also explained the relation between context and PPs, which we coded as occurrence.

Quantitative

The think-aloud protocols resulted in 3912 statements. The coded statements were summarised in ATLAS.ti in a code co-occurrence table to measure frequencies and proportions. The mean number of PPs discussed was 17, with a mean of 289 statements per interview. The frequencies and proportions of the components are listed in Table 3.2., as well as the PPs with the highest and lowest proportions in each component.

At the level of the individual PP, we found differences in the number of statements per PP, which might reflect a script's richness (25). PP Pain elicited the most statements (mean: 26.9 statements), and PP participation elicited the least (mean: 8.1 statements). We also found differences between the 20 PPs in the proportion of statements in the specific script components, which can indicate script maturity (25). For example, the range for the proportion of statements in the script component *enabling conditions* was 1.5% (PP addiction) to 18.3% (PP impaired mobility).

Script components	Frequency	Proportion % (range)		low-high
Consequences	1241	32	(12.4 - 42.4)	mobility (impaired) - addiction
Management	808	21	(10.9 - 27.8)	serious adverse events - mobility (impaired)
Explicative statements	660	17	(6.6 - 27.9)	fluid shortage - sleep pattern (disturbed)
Enabling conditions	417	11	(1.5 - 18.3)	addiction - mobility (impaired)
Fault	331	8	(0.5 - 18.1)	caregivers (strained) - wound healing (disturbed)
Impact	207	5	(1.8 - 11.7)	fever - social network (impaired)
Occurrence	147	4	(1.9 - 4.8)	fatigue - caregivers (strained)
Boundary	88	2	(0.5 - 6.1)	memory (impaired) - caregivers (strained)
None	13	0		
Total	3912	100		

Table 3.2. Frequencies and proportions of nursing script categories

Since we assumed that nurses would use explicative statements if causal bio-physical knowledge was irrelevant or not available, we inspected the data to find a pattern in the proportion of statements relating to *fault* or *explicative statements*. In the 4 areas of human functioning, nurses mentioned relatively more *explicative statements* than *fault* statements when talking aloud about PPs (Figure 3.3.).

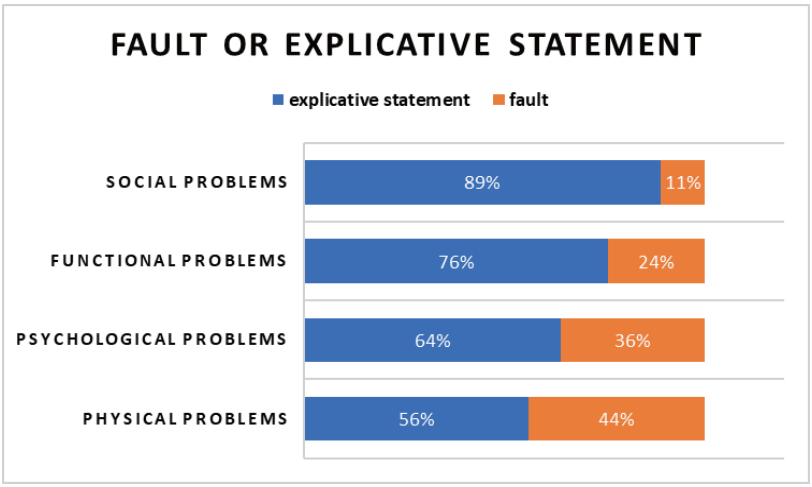

Figure 3.3.Patterns in explicative statements relative to fault

Discussion

To increase understanding of the nurses' clinical reasoning, we explored illness script theory applied to nursing. Through directed content analysis, we could identify scripts in the expert nurses' stories about PPs. In the qualitative results section, we presented the nursing scripts' building blocks or components. These findings can be depicted in a nursing script model (Figure 3.4.). In the quantitative analysis, we explored the richness and maturity of the nursing scripts and a pattern in the relationship between *fault* and *explicative statements*.

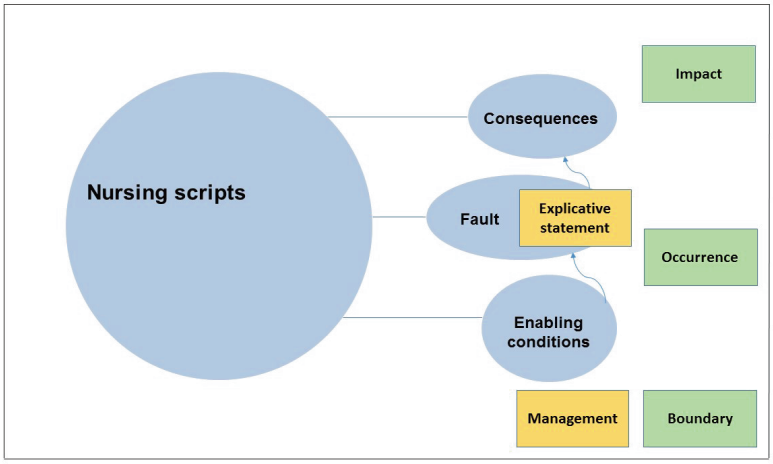

Figure 3.4. Nursing script model. Blue = original model; yellow = extended model; green = nursing additions

How can the nursing script model be characterised?

We asked the expert nurses to elaborate on PPs and not on medical diagnoses or illnesses. Nevertheless, we found a script model very similar to previous studies in medical research (18, 25). The distinct components of nursing patient problem scripts are related to medical illness scripts but have a special nursing flavour.

With regard to the illness script theory's original components, we found the highest frequency of statements about *consequences*, which corresponds with findings in medical studies (18, 25). A rich palette of signs and symptoms can facilitate recognition (18) of a PP and trigger reasoning processes. *Management* statements were mentioned frequently. Monajemi et al. (35) indicate that (medical) expertise is characterised by scripts with a high proportion of management knowledge. *Enabling conditions* are an important component of illness script theory. In our study, the nurses generally mentioned age, length of hospital stay, certain treatments and clusters of medical diagnoses. Knowledge about *enabling conditions* is acquired through experience. The ability to recognise *enabling conditions* is associated with early and accurate problem identification (25) and is a characteristic of expertise (44). In our sample, we found an overall proportion of *enabling conditions* of 11%, with variations between the PPs in the proportion of *enabling conditions*. Moreover, as an example, the larger proportion for the PP impaired mobility than for the PP addiction may be explained by the frequency of occurrence of these problems in our setting. This example supports the theory that knowledge about *enabling conditions* is related to growing expertise.

In this study, we found three nursing script model components with small proportions: *boundary*, *occurrence* and *impact*. Van Schaik et al. (24) suggest incorporating contextual factors like work environment into illness scripts. The components' *boundary* and *occurrence* in our nursing script model can be considered contextual factors that may also contribute to the context and domain specificity of clinical reasoning. *Impact* is probably the script component that best fits the nursing domain. Nursing concerns the impact of diseases on patients' lives, health improvement and future functioning (41, 45). Above that, "knowing the patient" and how a patient responds to a condition is a prerequisite for reasoning (42). Significant in nursing clinical judgement is also "what the nurse brings to a situation", which includes perceptions, values and opinions, which we also coded as *impact* (42).

The nursing knowledge of a PP's origin is captured in this study in both *fault* and *explicative statements*, which is possibly the most interesting result of this study. Pathophysiological malfunctioning is the content of the original *fault* component, and explanations or associations with behaviour or circumstances were coded in this study as *explicative statements.* According to illness script theory and evidence, experts rely less on *fault* knowledge and more on *consequences* and *enabling conditions* (25, 44). In this study, the frequency of both *fault* and *explicative statements* appears high, which seems to contradict illness script theory. A possible explanation may be found in the descriptive nature of the PP and in the fact that many PPs are associated with several causes or factors. However, more significantly, nurses mentioned explicative statements in all four types of PP, not only in the non-physical ones. In practice, nurses strive to understand the situation and do not

necessarily explain it (5, 46). Maybe it is this characteristic that is captured by the combination of *fault* and *explicative statements;* both knowledge types are probably necessary to enlarge understanding. Moreover, this might not only concern nursing, as recent medical literature about clinical reasoning argues for the integration of "biomedical explaining" and "patient understanding" (47-49).

Thus, combining *fault* and *explicative* statements could make illness script theory more applicable to all health professions and follow contemporary movements in professional attitudes about patient care that "call for a shift in clinical care away from underlying disease pathology toward understanding people" (47, p.49).

Illness scripts in nursing

This study contributes to outlining the features of nursing scripts in nursing clinical reasoning. According to illness script theory, reasoning in patient encounters is guided by individual scripts (17). Keemink et al. (25) state that mature expert scripts have a higher emphasis on *enabling conditions* and *consequences* than on *fault*. We encountered rich descriptions of *consequences* and *explicative statements* but fewer descriptions of enabling conditions by the expert nurses in our sample. We learned from illness script theory that recognising *consequences* and *enabling conditions* earns a distinct place in clinical teaching to enhance clinical reasoning (17). With our description of how our expert nurses think, we might better help our future students (30, 31). Based on this study, it may be advisable to add knowledge about *explicative statements, impact* and contextual knowledge to clinical teaching. In practice, nurse educators and preceptors can help students construct their illness scripts based on everyday patient experiences (2). Nursing scripts may offer students a tool to improve their understanding of PPs and thus enhance their clinical reasoning skills on possible explanations and potential deterioration risks (16).

Limitations

This explorative study's methods for data collection and analysis might influence validity and generalizability. We used the think-aloud protocol for data collection. Although this technique is frequently used to access cognitive processes, the outcomes are influenced by participants' ability to verbalise and describe their conscious thoughts (19). However, since it is impossible to directly observe cognitive processes, the think-aloud method is a state-of-the-art method to investigate the content of these processes (31). Although the sample size was relatively small, it is in line with other qualitative think-aloud studies (9, 30), and the interviews generated many statements about PPs that represented the 4 areas of human functioning.

We used directed content analysis as an established method to support or extend an existing theory. A known drawback of this method is that researchers are biased towards finding supportive evidence for the theory (27). To overcome this bias, we also applied open coding, kept a coding log, and 2 coders independently double coded 2 out of 13 interviews. This study's combined qualitative and quantitative analysis generated insight into nursing

clinical reasoning that enabled us to compose the proposed nursing script model, which needs to be validated in a different nursing sample.

Conclusion

Our aim was to explore the applicability of illness script theory in nursing and extend the scope of illness script theory. Our findings support the two hypotheses: The expertise in PPs of expert nurses can be described in a script, and the components of medical illness scripts—*enabling conditions*, *fault*, *consequences* and *management*—are also relevant in nursing.

We propose to extend the original illness script with the components *explicative statements*, *boundary*, *impact* and *occurrence* to make them specific for nurses. Illness script theory seems applicable to nursing, but in this study, the investigation was limited to the concept of illness scripts. Illness script theory also proposes an explanation of the learning path from novice to expert (22). Hence, before the impact of this study can be fully exploited, we recommend future research to:

1. Test our findings in a broader sample of nurses and students in and outside hospital to explore the development of scripts from novices to experts;
2. Validate the *explicative statement* component in other health professions;
3. Investigate the stability of nursing scripts: Would the nurses make the same statements again, at another time, with another interviewer?
4. Explore and test clinical teaching strategies based on nursing scripts.

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Evaluating clinical reasoning

Chapter 4
Development and validation of Dutch version of Lasater Clinical Judgment Rubric in hospital practice: An instrument design study

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Abstract

Background: Clinical reasoning in patient care is a skill that cannot be observed directly. So far, no reliable, valid instrument exists for the assessment of nursing students' clinical reasoning skills in hospital practice. Lasater's clinical judgment rubric (LCJR), based on Tanner's model "Thinking like a nurse" has been tested, mainly in academic simulation settings.

Objectives: The aim is to develop a Dutch version of the LCJR (D-LCJR) and to test its psychometric properties when used in a hospital traineeship context.

Design: A mixed-model approach was used to develop and to validate the instrument.

Setting: Ten dedicated educational units in a university hospital.

Participants: A well-mixed group of 52 nursing students, nurse coaches and nurse educators.

Methods: A Delphi panel developed the D-LCJR. Students' clinical reasoning skills were assessed "live" by nurse coaches, nurse educators and students who rated themselves. The psychometric properties tested during the assessment process are reliability, reproducibility, content validity and construct validity by testing two hypotheses:

1) a positive correlation between assessed and self-reported sum scores (convergent validity)
2) a linear relation between experience and sum score (clinical validity)

Results: The obtained D-LCJR, was found to be internally consistent, Cronbach's alpha 0.93. The rubric is also reproducible, with intraclass correlations between 0.69 and 0.78. Experts judged it to be content valid. The two hypotheses were both tested significant, supporting evidence for construct validity.

Conclusion: The translated and modified LCJR, is a promising tool for the evaluation of nursing students' development in clinical reasoning in hospital traineeships, by students, nurse coaches and nurse educators. More evidence on construct validity is necessary, in particular for students at the end of their hospital traineeship. Based on our research, the D-LCJR applied in hospital traineeships is a usable and reliable tool.

Introduction

As a result of the rise in the number of both acute and chronic cases in hospital practice, nurses are increasingly called upon to make rapid judgments under conditions of uncertainty (1, 2). The ability to make such judgments, together with adequate staffing levels, is the key to effective patient monitoring and may explain the better patient outcomes found in hospitals with more highly educated nursing staff (3). Effective clinical reasoning is a necessary competence in the making of these judgments: “Lives depend on competent clinical reasoning” (4). In line with this, the teaching of clinical reasoning is a key element of Dutch nursing curricula, and considerable attention is devoted to helping student nurses to acquire this competence during their traineeships.

To assess successful acquisition of these skills in practice, by direct observation, is not an easy matter (2, 5-7). The observations must be processed to give a score. This process of inference is prone to bias, susceptible to contextual factors and to the characteristics of students and assessors. An instrument, based on straightforward descriptions of observable behaviour, is needed to assess students' progress in acquiring clinical reasoning skills in traineeships. No reliable, valid instrument for the assessment of students' clinical reasoning skills in Dutch hospital settings has been available so far.

Background and purpose

Several definitions of clinical reasoning are proposed in English and American studies. They all agree on the interrelatedness of clinical reasoning, critical thinking and clinical judgment. Dutch researchers in this field, however, tend to consider that clinical reasoning includes critical thinking, data collection, analysis, reasoning, judgment and decision-making (8). In the present study, we use clinical reasoning as a collective term covering all these aspects.

Kathie Lasater (9) designed the Lasater Clinical Judgment Rubric (LCJR) to assess reasoning in academic nursing simulation classes. This rubric was chosen as a suitable starting point for development of an assessment tool for use in Dutch hospitals.

A Rubric is an ordinal scoring tool providing detailed description of expected behaviour at several performance levels (10). It facilitates observation-based assessment by allowing raters to match their observations to standard descriptions rather than basing scores on their own judgment. Lasater based her rubric on Christine A. Tanner's clinical judgment model “Thinking like a nurse” (11). Tanners model fits the Dutch conceptualisation of clinical reasoning (Fig. 4.1.).

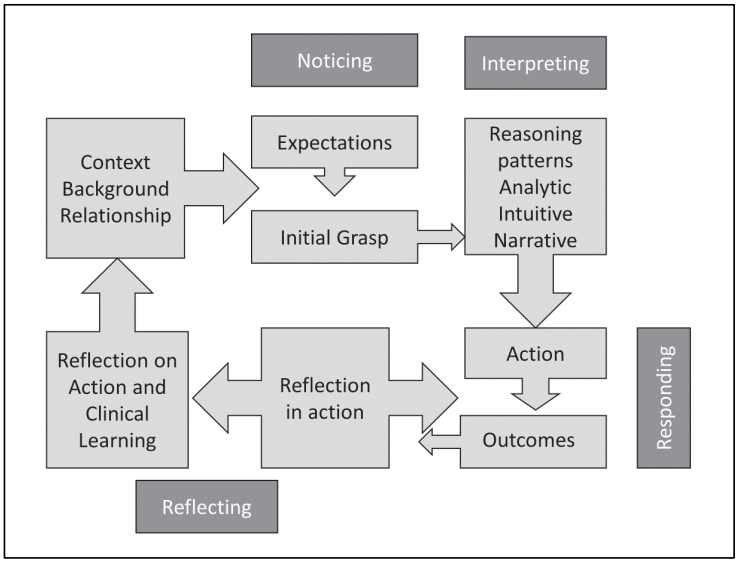

Figure 4.1. Clinical Judgment Model, adapted from Tanner (2006)

Lasater (9) used the four processes Noticing, Interpreting, Responding and Reflecting as the four phases of her rubric, operationalized in eleven items. Lasater used the studies of Benner et al. (12) and Tanner (11) to describe the expected behaviour at four developmental levels ranging from expert to novice (exemplary, accomplished, developing, beginning). Thus, this rubric is an 11 × 4 table that can be used to quantify competence development. Each behavioural descriptor at the beginning level scores 1 point, at the developing level 2 points and so on. Total scores of up to 11 indicate that students' clinical reasoning skills are at the beginning level, while those in the range 12–22 correspond to the developing level, 23–33 to accomplished and 34–44 to exemplary (13).

The LCJR has been validated in the USA (5, 14-17) and translated and validated in Sweden (18) and South Korea (19). Validation took place in academic simulation settings. Cronbach's alpha varied between 0.86 (Sweden), 0.90 (South Korea), and 0.97 (US). Intraclass coefficients of 0.86 (Sweden) and 0.89 (US) were found. Evidence for construct validity was found by Shin et al. (19) with the aid of confirmatory factor analysis and by Sideras (5) using Student's t-test (which found a significant relation between known groups); ANOVA analysis of clinical validity at different levels of complexity showed no significant relation, however. Strickland (16) and Sideras compared students' self-assessment with assessments by teachers and found a moderate positive correlation.

Purpose

The objectives of this study are to obtain a Dutch version of the LCJR and to test its psychometric properties on nursing students during their hospital traineeship. Reliability will be assessed and evidence of validity will be collected by researching two hypotheses:

Hypothesis 1. The mean sum scores of the assessments of students' clinical reasoning skills by nurse coaches and nurse educators correlate positively with the self-reported scores of students and the differences between raters are not significant (homotrait-multimethod correlation, testing for convergent validity by comparing assessed and self-assessed scores).

Hypothesis 2. There is a positive linear relationship between students' hospital experience and their mean sum score, as assessed by coaches and nurse educators; the greater the experience, the higher the sum score (clinical validity).

Methods

A mixed-model approach, the Instrument Design Model (20) was used to translate, customize and to test the rubric. A qualitative data collection for instrument development was followed by quantitative validation.

The first step of this study is the production of the D-LCJR, the Dutch version of the LCJR. The second step is testing the properties of D-LCJR: internal consistency (Cronbach's alpha), reproducibility, bias, feasibility, content validity and construct validity. The reproducibility was measured by four intra-class correlations (ICC 1,2) (21): overall, between student and nurse coach, between student and nurse educator and between nurse coach and nurse educator and post-hoc power analysis. The limits of agreement and bias were assessed with the aid of Bland-Altman plots. The feasibility was expressed as a numeric rating score (NRS) and the content validity as a content validity index (CVI). Construct validity was tested with reference to the abovementioned two hypotheses.

The setting is a Dutch university medical centre (VUmc) where nursing students are trained in dedicated educational units (DEU). DEU's are located on normal surgical and medical care units. The prevailing educational model is “learning by doing”. Students provide patient care, receiving situational coaching e.g. when student's competence is not congruent with patient complexity. They learn “on the job” from experienced nurses, well-trained in coaching. Certified nurse educators organize learning and coaching on DEU's. DEU student teams are heterogeneous. Students have different lengths of hospital nursing experience and are in different study years. They are trainees or employed apprentices and study on two educational levels (bachelor and intermediate). The length of a traineeship is 10 to 40 weeks.

A Delphi panel was set up of to deal with the qualitative data collection stage. A college teacher in nursing, an English native speaking nursing scientist, an educational scientist, a recently graduated nurse and a very experienced nurse coach agreed to critically judge the translation and to rephrase items to make the rubric applicable in our setting.

The participants in the quantitative stage were nursing students, nurse coaches and nurse educators. The participation of students and nurse coaches was voluntarily and could be waived at any time. Nurse coaches, students and nurse educators were asked to sign an informed consent letter. Students were eligible to participate if they were able to take care of allocated patients. Assessment was stopped in cases where patients showed acute deterioration in their condition.

Seven experts (senior nurses, teacher, nurse educators, educationalist, student), not involved in the assessments, were asked to determine the content validity index (CVI).

The students and nurse coaches participating in the study formed a non-probable convenience sample: they were scheduled to work on three assessment mornings. The desired sample size was 54 students. According to the Cosmin checklist (22) this number is

sufficient for psychometric testing. In view of the time-consuming nature of the assessment, a larger sample would not have been possible.

All nurse educators were instructed in the use of the Dutch version of the LCJR by the researcher. Nurse coaches and students were informed by their nurse educators. Nurse coaches were provided with the specimen questions formulated by Lasater (1) to guide them. For example, in the reflecting phase students may be asked: “What would you have done differently?”

Permission for conducting this research was given by the management of DEU's, Nurse Education department and the ethics committee of the Netherlands Association for Medical Education (NVMO).

Data collection

The Delphi panel was asked to modify the Lasater Clinical Judgment Rubric, translated into Dutch by the researcher. This procedure should end when overall agreement is reached. The panel used several email rounds from December 2015 to February 2016.

The data collected for validation were derived from assessments by coaches and educators and student self-reporting. The data collection reflects actual learning and assessment conditions, and is not based on simulation. The assessments took place at ten DEUs on three mornings in May and June 2016. During 3 h students were observed. Each observation started with the usual discussion of complaints, treatment and care between student and nurse coach.

The observed student activities are: collecting necessary clinical information, meeting patients, taking care of patients, dispensing medication and accompanying the doctors on the ward round. On each morning two students were assessed by one nurse coach and nurse educator and students also rated their own performance, resulting in three scored rubrics per student. All rated the 11 items of the rubric independently on a scale of 1 to 4, and assessed the feasibility of the rubric on a scale of 1 to 10. Data collection for content validity took place by email in May and June 2016.

Analysis

The Delphi panel used Track Changes to communicate suggestions for improvement, by email. D-LCJR assessment data for each student were stored in an Excel file and provided with a student identifier. Data were analysed with the aid of Excel and R 3.2.2 and R studio 099.489. The R packages used were graphics, mosaic, stats, eRm, psych, irr, foreign, base, QuantPsyc, ICC and SampleSize.

Results

Qualitative

The LCJR was translated into Dutch by the researcher (JV). The draft D-LCJR was modified to take Dutch conditions into account by a Delphi panel in two email rounds. The first round yielded 23 suggestions for rephrasing descriptors. In the second round all suggestions were

accepted and the reversal of the levels was added by one member. In the final round consent was reached. One of the five panel members left the hospital. The final version of the D-LCJR is shown in Table 4.1. The panel rephrased some items, using Dutch expressions. Features of our teaching practice, such as discussing a patient's condition with the nurse coach, were included. An important difference between the original rubric and the Dutch version is the reversal of the development levels. Lasater rates students from exemplary to beginner. The panel suggested that it would be more in line with Dutch practice, to arrange the scoring from beginner to exemplary.

Quantitative

Fifty-two of the planned fifty-four students were assessed using the D-LCJR, in each case by the student him- or herself, by a nurse coach and by a nurse educator. Details of the participants are given in table 4.2. The sample reflects the study population.

N	**52**
Educational path	Trainee 27 (51.9%) Employed apprentice 25 (48.1%)
Study years **1** **2** **3** **4**	Median: 3rd year 9 (17.3%) 9 (17.3%) 23 (44.2%) 11 (21.2%)
Schools **Intermediate college** **Baccalaureate colleges**	 24 (46.1%) 28 (53.8%)
Hospital experience in months	11 months (median) Range 1-41
Raters: **Students** **Coaches** **Nurse educators**	 52 26 10

Table 4.1. Participants

Dutch Lasater Clinical Judgment Rubric				
Ontwikkel fase	**Beginnend**	**In ontwikkeling**	**Bekwaam**	**Expert**
Effectief Opmerken				
1.Doelgerichte observatie	De klinische situatie en de hoeveelheid gegevens leiden tot verwarring; observeert ad hoc en belangrijke gegevens worden niet gezien, en/of verkeerd geïnterpreteerd. Weet niet welke gegevens doorgegeven moeten worden. Kan nog geen betekenis geven aan dat wat is gezien	Probeert een aantal objectieve en subjectieve gegevens te bewaken, maar raakt overspoeld door de hoeveelheid gegevens; richt zich op de meest opvallende gegevens, ziet soms belangrijke informatie over het hoofd doordat het ziektebeeld niet bekend is. Vergeet belangrijke gegevens door te geven	Observeert en bewaakt doorlopend een aantal symptomen en signalen; de meeste bruikbare informatie wordt opgemerkt, mag zeer subtiele signalen missen	Observeert doelgericht; observeert en bewaakt doorlopend een grote hoeveelheid van objectieve en subjectieve gegevens om alle bruikbare informatie op te sporen
2.Afwijkingen en veranderingen herkennen	Richt zich op één observatiepunt en veranderingen en afwijkingen worden niet gezien; vraagt niet door	Merkt de meest opvallende afwijkingen en veranderingen op maar niet alle. Weet niet goed welke aanvullende gegevens nodig zijn	Merkt bijna alle opvallende veranderingen en afwijkingen op en doet aanvullend onderzoek	Merkt kleine, subtiele veranderingen en afwijkingen op en doet aanvullend onderzoek en gebruikt deze gegevens om de situatie te beoordelen/evalueren (en bespreekt dit met de coach) en handelt hiernaar
3. Gegevens verzamelen	Vertrouwt het meest op meetbare gegevens; vindt interactie met de patiënt en familie moeilijk en verkrijgt daardoor minder informatie van patiënt en familie over de toestand van de patiënt. De informatie beklijft nog niet goed	Probeert voorzichtig extra informatie van patiënt of familie over de toestand van de patiënt te verkrijgen; weet veelal niet welke informatie nodig is, vraagt niet door of verzamelt onnodige informatie	Vraagt actief door aan patiënt en familie om gegevens over de toestand van de patiënt en verwachtingen over de zorg te verkrijgen; mist soms een belangrijk aanknopingspunt doordat het ziektebeeld nog onbekend is	Neemt initiatief om door gerichte observatie en interactie met patiënt en familie alle noodzakelijke informatie te verkrijgen over de toestand van de patiënt en verwachtingen over de zorg
Effectief interpreteren				
4.Gegevens ordenen	Lijkt niet te weten welke gegevens een diagnose ondersteunen, vindt het moeilijk om hoofd- en bijzaken te scheiden	Probeert hoofd- en bijzaken te scheiden, maar besteedt ook aandacht aan minder relevante gegevens	Beperkt zich meestal tot de belangrijkste gegevens maar blijft zoeken naar meer gegevens. Kan schakelen tussen patiënten en situaties	Beperkt zich tot de belangrijkste gegevens om de toestand van de patiënt te verklaren
5.Gegevens begrijpen	In gewone, bekende, niet- complexe situaties is het moeilijk om de beschikbare gegevens te begrijpen en te verklaren. Heeft hulp nodig bij probleem vaststellen en zorg plannen. Tempo van informatie verwerken is nog traag	Kan in gewone, bekende, niet-complexe situaties gegevens linken aan verpleegkundige/medische kennis en de zorg plannen en uitleggen; kan nog moeite hebben met verbanden leggen in midden complexe, of onverwachte situaties; heeft vaak hulp en advies nodig	In de meeste situaties in staat zijn om verbanden te leggen en gegevens te linken aan verpleegkundige/medische kennis. Kan zorg plannen en onderbouwen; uitgezonderd zijn complexe situaties waarin hulp gevraagd mag worden van een collega/coach	Zelfs in complexe situaties met tegenstrijdigheden in staat zijn om a) verbanden tussen gegevens te leggen b) gegevens te linken aan verpleegkundige/medische kennis en c) interventies te plannen waarvan verwacht kan worden dat deze tot resultaat leiden

Ontwikkel fase	Beginnend	In ontwikkeling	Bekwaam	Expert
Effectief reageren				
6. Rustig en met zelfvertrouwen	Is, behalve in eenvoudige routine situaties, chaotisch, gespannen en heeft het werk nog niet onder controle. Kan zich zelf overschatten of durft nog niet zelf te doen, kijkt liever mee. Patiënt en familie kunnen onzeker worden	Is aarzelend in de regie nemen; in eenvoudige en routine situaties geeft ze patiënt en familie een veilig gevoel. Kan makkelijk chaotisch en gespannen worden. Kan nog niet begrenzen, willigt alle verzoeken in.	Laat regie en zelfvertrouwen zien. Heeft de meeste situaties onder controle. Kan stress laten zien in complexe situaties. Kan schakelen tussen situaties	Neemt de verantwoordelijkheid op zich; delegeert taken aan collega's; beoordeelt de situatie en geeft patiënt en familie een veilig gevoel
7. Communicatieve bekwaamheid	Vindt communiceren moeilijk; uitleggen gaat rommelig, vergeet delen van informatie bij het informeren van de patiënt; aanwijzingen zijn onduidelijk of tegenstrijdig; patiënt en familie raken in de war en voelen zich niet veilig/verzekerd. Vermijdt telefonisch communiceren	Laat communicatievaardigheden zien (b.v. instructie geven); communicatie met collega's, patiënt en familie is deels in orde; zet zich in om effectief te communiceren maar is hierin nog niet bekwaam	Communiceert meestal effectief; legt zorgvuldig uit aan de patiënt; geeft heldere aanwijzingen aan collega's, kan nog duidelijker om medewerking vragen	Communiceert effectief; legt handelingen uit, stelt de patiënt en familie gerust; betrekt en stuurt collega's aan, legt uit en geeft aanwijzingen; gaat na of het begrepen is
8. Handelen volgens zorgplan of protocol/flexibiliteit	Richt zich op de uitvoering van een enkele, juiste, interventie maar kan nog niet de puntjes op de i zetten; observeert een deel van de reacties van de patiënt.	Handelt volgens zorgplan/protocol; observeert de voortgang maar kan het handelen nog niet aanpassen aan de reacties van de patiënt	Handelt op basis van de toestand van de patiënt; houdt de voortgang in de gaten maar verwacht niet zelf het protocol/zorgplan aan te moeten passen	Zorgplan/protocol is geïndividualiseerd; bewaakt de toestand van de patiënt nauwgezet en kan handelen aanpassen aan de reacties van de patiënt. Kan werktempo aanpassen als de situatie daarom vraagt
9. Vakbekwaamheid	Beheerst de technische handelingen nog niet, is erg gericht op het leren van handelingen	Is aarzelend in het uitvoeren van technische handelingen, is gericht op de handeling en minder op de patiënt	Laat zien dat ze de technische handelingen beheerst; het kan nog sneller of met meer precisie	Laat zien dat ze de technische handelingen beheerst
Effectief reflecteren				
10. Zelf-evaluatie	Evalueert op verzoek oppervlakkig, niet gericht op verbetering maar op verdediging; motiveert eigen besluiten zonder achteraf te evalueren	Evalueert op verzoek maar blijft op de vlakte; vindt het moeilijk alternatieven te bedenken; schiet snel in de verdediging tijdens het evalueren van zelfgemaakte keuzes	Analyseert en evalueert eigen professioneel gedrag, herkent belangrijke beslismomenten en overweegt alternatieven	Analyseert en evalueert kritisch eigen professioneel gedrag, herkent beslismomenten, overweegt alternatieven en evalueert eigen keuzes
11. Leerhouding	Herkent de noodzaak tot continue verbeteren nog niet; is te weinig of over- kritisch over de eigen inbreng; herkent nog niet tekortkomingen in de zorgverlening. Kan nog geen juiste bronnen selecteren/raadplegen	Laat zien dat ze zich ervan bewust is dat continue verbeteren nodig is; probeert te leren van ervaringen aan de hand van vragen van de coach	Laat gemotiveerdheid zien in continu verbeteren; evalueert de verleende zorg; herkent wat goed gaat en beter kan; durft dit naar voren te brengen	Laat gedrevenheid zien in continu verbeteren; is kritisch over de verleende zorg; onderzoekt systematisch wat goed gaat en beter kan; neemt initiatief tot verbeteringen

Table 4.2. Full text of Dutch version of Lasater's clinical judgment rubric, D-LCJR

The mean scores obtained on the D-LCJR items are given in Table 4.3. The assessments took place at the end of school year. Only 0.9% of the data were found to be missing. They were assumed to be missing completely at random (MCAR) and imputed with mean item scores. Interpreting seems to be the most difficult phase for students. With the means of three ratings the students were assigned to the four development levels, in accordance with Lasater's instructions (17). This led to the following distribution: the beginning class (score 11) is empty, 9.6% of students were rated as developing (score 12–22), 58% as accomplished (score 23–33) and 32.7% as exemplary (score 34–44).

Item	Mean student (SD)	Mean nurse coach (SD)	Mean nurse educator (SD)	Missing (n=156)
Noticing phase				
Focused observation	2.88 (0.55)	2.87 (0.79)	2.79 (0.67)	
Recognizing deviations	2.69 (0.7)	2.79 (0.76)	2.65 (0.74)	
Information seeking	3.1 (0.63)	2.88 (0.76)	2.96 (0.66)	
Interpreting phase				
Prioritizing data	2.65 (0.62)	2.67 (0.76)	2.67 (0.71)	
Making sense of data	2.69 (0.58)	2.58 (0.61)	2.52 (0.73)	
Responding phase				
Calm, confident manner	3.12 (0.65)	2.84 (0.64)	2.75 (0.71)	2
Clear communication	3.17 (0.71)	2.88 (0.65)	2.75 (0.71)	2
Well planned intervention/flexibility	3.06 (0.75)	2.78 (0.60)	2.77 (0.96)	4
Being skilful	2.82 (0.90)	2.80 (0.89)	2.81 (0.95)	3
Reflecting phase				
Evaluation/self-analysis	3.1 (0.63)	2.97 (0.73)	2.92 (0.62)	2
Commitment to improvement	3.06 (0.61)	2.94 (0.78)	2.73 (0.66)	3
Sum score	32.34 (5.29)	30.93 (6.31)	30.32 (6.56)	16 (0.9%)

Table 4.3. D-LCJR scores

The mean feasibility of the D-LCJR was scored as 7.07 on a scale from 1 to 10. (SD 1.29, range 3–10, n = 119). Thirty-seven participants missed this question, possibly due to the layout of the Rubric score form.

Internal consistency was high, with Cronbach's alpha = 0.93 (95% CI 0.92–0.95). Three items (Information seeking(3), Evaluation/self-analysis (10) and Commitment to improvement (11) scored higher than average (r = 0.56, range 0.55–0.58) and showed lower correlations with the remaining eight items (range: 0.67–0.84).

Reproducibility, expressed in overall intra class correlation (ICC), was 0.72 (95% CI 0.61–0.82). The ICCs of the three pairs were: student and nurse coach 0.7(95% CI 0.53–0.81), student and nurse educator 0.69 (95%CI 0.52–0.81) and nurse coach and nurse educator 0.78 (95% CI 0.64–0.86). Post-hoc power analysis of the overall ICC(1,2) gave a power of 0.91, meaning that the likelihood of a false negative correlation is 9%. The magnitude of the differences between the three rater pairs was measured using the Bland-Altman procedures: plot, slope of regression line, significance, bias and Limits of Agreement.

The Bland-Altman plots for the three rater pairs are shown in figure 4.2. Comparison between students and nurse educators (first plot) gives a bias of 2 points, which is significant (6,1%, $p = 0.02$) and limits of agreement of −6.53 to 10.56. The second plot (for students and nurse coaches) gives a bias of 1.3 points (3.9%, $p = 0.07$), while the final plot (nurse coaches and nurse educators) gives a bias of 0.69 points (2,1%, $p = 0.68$) and limits of agreement of −9.14 to 7.77.

Five of the nine experts consulted scored the content validity index (Lynn, 1986) for the D-LCJR, finding a mean CVI of 85%. This indicates that the content validity is acceptable. Two items (Calm, confident manner (6), Being skillful (9)) scored lower than Lynn's norm of 83% (5 raters, $p < 0.005$).

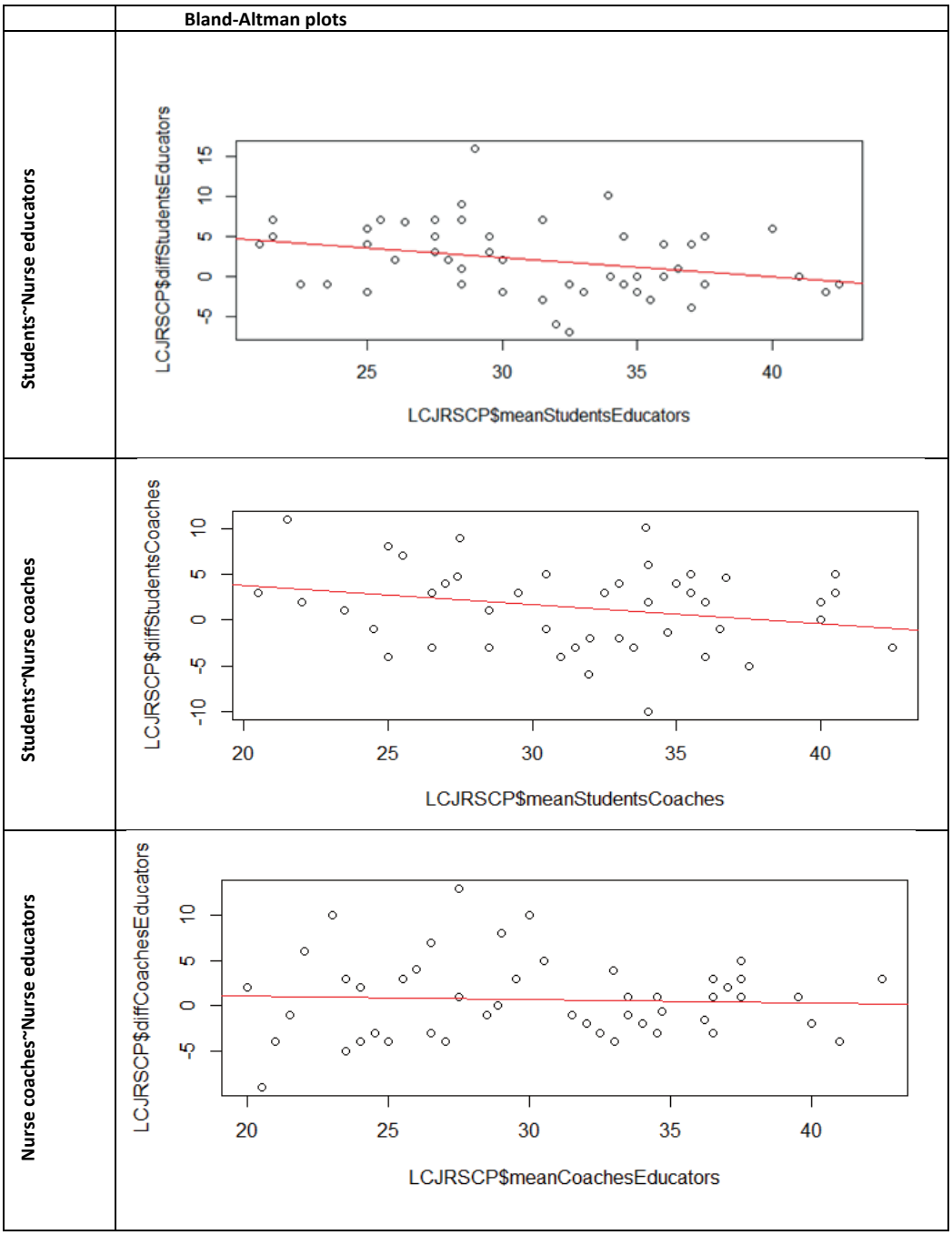

Figure 4.2. Bland Altman plots

Two hypotheses were tested to find evidence for construct validity. The correlation of students' sum scores as determined by the three raters was studied to test for convergent validity. The three boxplots presented in Fig. 4.3 give an indication of interrater agreement. Students rate themselves higher, while nurse coaches show the widest range of sum scores.

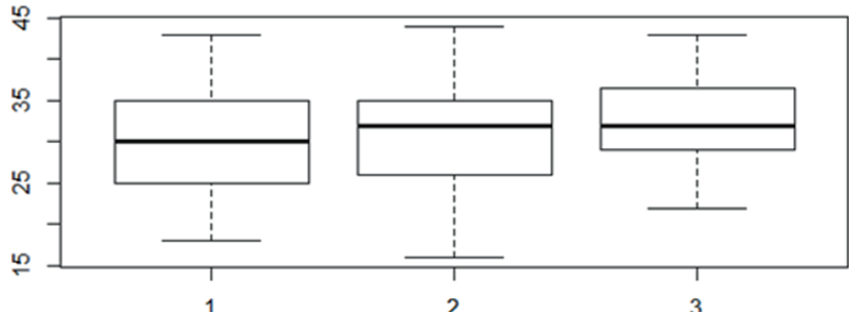

Figure 4.3. Boxplots of interrater agreement on sum scores. != nurse educator, 2= nurse coach, 3=student

An alternative approach is to study a scatter plot of the self-rated scores of students against the mean sum of the scores determined by nurse coaches and nurse educators, as shown in Fig. 4.4. This shows a positive linear relationship with a high correlation (Pearson's r = 0.78, 95%CI 0.64 to 0.87). A t-test revealed that the differences between students' self-rating and the mean scores determined by nurse coaches and nurse educators were not significant (p = 0.137) and 95%CI (−0.54–3.89).

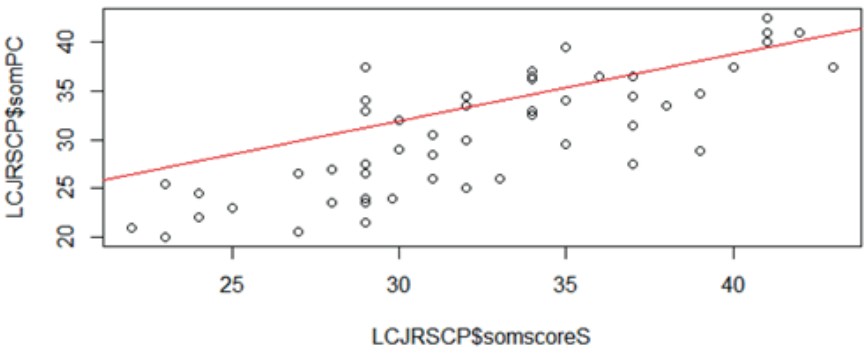

Figure 4.4. Scatterplot of students' self-assessment sum scores against scores determined by nurse educators and nurse coaches

Hypothesis 2, concerning the relationship between students' hospital experience and their mean sum scores, was tested to provide evidence of clinical validity. The scatter PLOT OF students' mean sum score as determined by self-rating, coaches and nurse educators against their hospital experience (in months) is shown in Fig. 4.5.

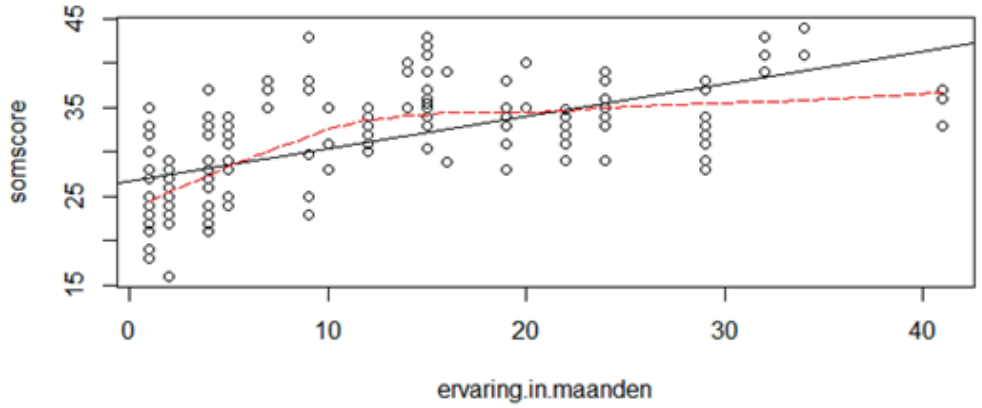

Figure 4.5. Scatter plot of sum scores against experience in months (n=156)

The red LOWESS line representing the relationship between experience and sum score is shown together with the trend line in black. The LOWESS line flattens off for the most experienced students. Pearson's r = 0.62 (95%CI 0.51 to 0.71) as determined by ANOVA is significant ($p < 0.001$).

Discussion

This study was motivated by the desire to find a reliable, valid instrument for measuring the development of nursing students' clinical reasoning during their hospital traineeship. A rubric intends to measure not-observable skills on the basis of their behavioural descriptions. A Dutch version of Lasater's clinical judgment rubric was produced in the qualitative stage of this study. It was decided that the usual back translation of the Dutch version could be waived because of presumed cultural and language differences between US and Dutch nursing students. But comparison of the D-LCJR with the LCJR did not reveal any substantial cultural differences. This is consistent with the findings of Luiking et al. (23): nursing practices in the US and in the Netherlands show more similarities than differences.

Raters gave the D-LCJR a mean feasibility score of 7.07 on a scale of from 1 to 10 (1 = not feasible, 10 = very feasible). The use of rubrics is new in this setting, and the wide range of scores reported (3 −10) shows that this instrument has opponents as well as supporters. Opponents may need more time to get used to this tool (see e.g. the US teaching aids platform TeachersFirst: The web resource by teachers, for teachers. The rubric is designed as an assessment tool and consists of a set of explicit descriptions of various aspects of a certain skill (24). These concisely formulated descriptors can help nurse coaches and nurse educators to exchange views about students and expectations, and can thus support feedback to students. It has been shown that the use of rubrics promotes continuity and consistency among raters (25). The descriptors can help students to understand what is expected of them. The precision of the descriptors can promote learning and can also provide students with motivation (25) and the language they need to set improvement goals (15).

Cronbach's alpha is high at 0.93 (95% CI 0.92–0.95). This indicates that the rubric is internally consistent, all items contribute to a single construct. The items are interrelated, but there are some signs of redundancy. Since all items are based on Tanner's "thinking like a nurse" model and Crombach's alpha is high, removing items was not considered.

According to Landis and Koch (26), the reproducibility of the D- LCJR is substantial with an overall ICC(1,2) of 0.72 (95%CI 0.61–0.82). All four calculated ICC's were lower than those found in previous studies. This might be due to the lack of variance in sum scores (the empty 'beginning' class) and the fact that raters did not receive rigorous training. The differences in sum scores found in this study are low, indicating that the variance found is the true variance and not due to rater error. The Bland-Altman procedures show that the ratings determined by nurse coaches and nurse educators are exchangeable, which enlarges the applicability of the D-LCJR in practice. The differences in sum scores between students and nurse educators are systematic and significant but small: students tend to rate themselves a significant 6.1% higher than nurse educators. If the D-LCJR is used, as intended, as an evaluation and feedback tool and not for passing-failing decisions, the reproducibility, agreement and bias are adequate. Previous studies (5, 14, 15, 18, 27, 28) established the reliability of the LCJR in academic simulation settings and largely endorse our findings, though they found the psychometric performance of the LCJR to be better than that of the Dutch version in hospital setting. The D-LCJR shows adequate content validity (CVI 85%, $p < 0.005$), though two items (Calm, confident manner (6) and Being skillful (9)) were considered less relevant. CVI might improve by eliminating or rewriting items.

We found evidence for two aspects of construct validity by testing two hypotheses. The self-rating of students correlates well with the combined observed ratings by nurse coaches and nurse educators ($r = 0.78$) and the differences are not significant with a 95% CI including 0 and $p = 0.137$ in this sample. Statistical analysis revealed a positive linear relationship with a high correlation (Pearsons's $r = 0.62$) between sum scores and experience. Both hypotheses could not be rejected in this study, which provides evidence of construct validity (convergent and clinical validity). However, the relation between experience and sum score was weaker for the most experienced students. This latter point in particular requires further research. One explanation might be 'the intermediate effect' (6). For example, more experienced students need less information to act on. It is difficult to match this kind of efficient behaviour with the descriptions in the rubric. Furthermore, experience in weeks may not be the best measure of the independent variable experience.

Limitations

Some work remains to be done to improve the psychometric properties and usability of D-LCJR in hospital setting.

There are indications for floor and ceiling effects, not mentioned in earlier studies. Our students achieved relatively high scores. The beginning class was empty. The sum scores found for the most experienced students tended to be lower than predicted by the assumed linear relation. These effects lower the variance and hence the estimated reliability of the rubric,

resulting in lower ICC's. The higher sum scores found might indicate that routine in procedures plays an important role in the development of clinical reasoning. Routine is more easily achieved in traineeships than in simulation classes. Alternatively, the descriptions given in the D-LCJR under the heading 'beginning' may actually refer to clinical judgment skills that are too elementary for first year nursing students.

Assessments performed with the aid of the D-LCJR might be influenced by contextual factors such as time, number of patients, shift characteristics, etc. Despite evidence that these factors can influence scoring (29), they were not taken into account in the present study. The possible influence of patient complexity was also neglected. Sideras (5) could not establish presumed inter- action between complexity of simulation scenarios and LCJR scores. It might be possible to overcome these sources of uncertainty by assessing students more than once. The omission of context and patient complexity may restrict the generalizability of this validation study of D- LCJR.

Assessments are usually subject to measurement bias (6). Rater training is advisable to reduce bias and improve reliability (5, 14, 30). There is however never enough time to instruct all nurse coaches of a hospital. Since our students are used to work under supervision, the observer effect may be relatively low. However, different raters may concentrate on different aspects of behaviour, may weigh them differently or have different expectations (5, 6). We found little evidence of measurement bias in this study. The raters knew the students well and the score might reflect earlier observations and judgments, giving rise to a primacy effect. All bias can lead to over or underestimation of ICCs (6).

Self-assessment is difficult. Accurate self-knowledge is hard to achieve. Over and underrating is possible; it can be reduced by the use of well-defined descriptors (31), as in a rubric.

Validation means building a case based on arguments and research, and is never complete. Confirmatory factor analysis to test the structure of the four phases in our rubric and thus to find more evidence for construct validity was not possible, because of the small sample size.

Implications for Practice and Clinical Relevance

The studies performed so far show that the LCJR can be used in three different ways: for self-assessment, for evaluation and feedback and for outcome measurement in research (29, 32, 33).

There are multiple advantages to using the D-LCJR during traineeships. The D-LCJR expresses what nurse coaches and nurse educators expect from students' clinical reasoning (7, 15). Students can use the rubric to articulate their learning goals and the D-LCJR can be used by nurse coaches and nurse educators to assess students' progress during hospital traineeships, or by the students to assess themselves.

Suggestions for Further Research

Two possible lines for future investigation may be proposed. How can the floor and ceiling effects on assessment of student performance with the aid of the D-LCJR be reduced?

And, since validation is not only about instruments and raters but also about setting, further study of the rubric in settings with different contextual factors or different patient complexity might improve its generalizability.

Conclusion

Our aim was to develop an instrument, similar to Lasater's clinical judgment rubric, that could be used by Dutch nursing students, nurse coaches and nurse educators to measure students' progress in acquiring clinical reasoning skills during hospital traineeships.

The D-LCJR, translated and modified, shows considerable promise as a tool for students, nurse coaches and nurse educators to evaluate clinical reasoning skills in hospital traineeships. Based on our research results, the D-LCJR applied in hospital traineeships is a usable, reliable and valid tool. More evidence on construct validity is necessary, in particular for most experienced students.

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Teaching clinical reasoning in practice

Chapter 5
Debriefing to nurture clinical reasoning in nursing students: A design-based research study

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Submitted

Abstract

Background: Students' clinical reasoning can be stimulated by guiding them to use their experiences with patients to develop own illness scripts. Debriefing during hospital shifts invites students to put patient experiences into words, link them to previously acquired knowledge and make connections.
Objectives: To develop, implement and evaluate a debriefing procedure for nursing internships based on illness script theory and generate corresponding design principles. *Design:* Qualitative design-based research.
Setting: Clinical education in dedicated educational hospital units.
Participants: Nurse educators, nursing students.
Methods: From a collaboration between nurse educators and a researcher, a short, peer-debriefing procedure was designed, tested and enacted through four cycles of planning, action, evaluation and reflection**.** Students drew mind maps about patients. Nurse educators and students joined focus group discussions to evaluate outcomes and processes. Mind map and iterative thematic analysis were applied to these data.
Results: An adjusted design and more extensive design principles resulted. Differences in mind maps were evident over time. Three themes in the process evaluation were established: trigger to reason; energy giving and taking; and form follows function.
Conclusions: Nurse educators can design and implement debriefing procedures to facilitate students' clinical reasoning skills. The method integrates research, innovation and collaboration. The design and enactment under real-life hospital conditions generated design principles relevant for educators aiming to improve the teaching and learning of clinical reasoning in practice. Clarification is needed about the path from design through enactment to real practice change.

Introduction

Nursing students must develop sound clinical reasoning; recognising and responding to patients' signs is crucial for patient outcomes and safety. However, learning it in clinical training is challenging (1). Clinical reasoning is multifaceted, including philosophical, structural and technical aspects (2). It can be considered an individual cognitive task or a process situated in context, in collaboration with patients and (inter)professional co-workers (3, 4). Nursing schools teach theoretical knowledge, but learning reasoning about real patient problems occurs in practice where it is applied (5). Hence, students have to learn to recognise signs and symptoms, categorise and cluster relevant clinical features, link them to patient problems or possible diseases and develop pattern recognition (6).

Background

Teaching clinical reasoning is also challenging for nurse supervisors and educators. Experienced nurses have encapsulated, integrated clinical knowledge (7), so their explanations might miss the details students need to understand and deploy clinical reasoning effectively. The best approaches for developing reasoning skills in practice have not yet been investigated. What can students, supervisors and educators do to strengthen the necessary practice-based knowledge?

To develop clinical reasoning, the mental organisation of knowledge is as important as its acquisition (8). One strategy is to facilitate students in organising experiential knowledge to enable them to build their own illness scripts (9, 10), which are mental models based on patients cared for in practice and facilitate clinical reasoning (11). They form knowledge structures containing different components and linking relationships. Illness scripts are used by experts to perceive a situation's features, assess relevant hypotheses, give meaning to clinical situations and activate prior knowledge to interpret new information (9, 12, 13). Script-building is an individual exercise and scripts cannot be directly taught (11). How health profession education students with different prior knowledge levels and skills create illness scripts from practical experience has not been investigated (14).

One way to stimulate students to reflect about experiences and process information is debriefing through verbalising, summarising, mapping, drawing or visualising (15, 16). Debriefing can be used to promote reflection on interactions with patients and articulation of patient findings. It is assumed to improve learning and support building students' own illness scripts (10, 17). Moreover, interaction with colleagues in the same situation stimulates clinical reasoning (2, 3, 18).

Study aims

This study aimed to design a debriefing technique suitable for clinical practice that supports nursing students in making sense of patient data and building personal illness scripts. The second aim was to generate design principles for developing and introducing debriefing in clinical practice. Design principles guide design and intermediate between theory and local practical experiments (19). Based on our knowledge of illness scripts in nursing (13) and

Lubarsky's assumption that further development of script-conscious educators and students will promote sound clinical reasoning (11), we aimed to improve the teaching and learning of clinical reasoning in clinical practice. Our investigation is guided by the following research question:

How can we foster students in organising their experiential knowledge of patients through a debriefing procedure in clinical practice? Which supportive design principles can be distinguished from the design development process?

Methods

Study approach

We chose a design-based research (DBR) approach with a qualitative design to investigate the process and outcomes, informed by McKenney and Reeves's book on educational research design (19). The DBR cyclic process leads to a useful practical intervention and an advanced theoretical understanding articulated in design principles (19). The study was designed in the interpretivist research paradigm, wherein the construction of meaning and understanding is a consequence of participant–researcher interactions in a natural setting (20).

Design-based research cyclic process

We conducted four cycles to answer our research questions (Figure 5.1.). Cycle 1 took place in June 2022 and Cycle 2 from July to October 2022. The try-out (Cycle 3) was organised at the end of October, and the implementation (Cycle 4) started at the end of November and lasted until February 2023, the end of the students' practice placement. In DBR, the design, test, evaluate and reflect processes can be infinite. For this study, we operationalised data sufficiency after four cycles, with enactment and evaluation of more than six units, expecting sufficient insight into the design and its principles.

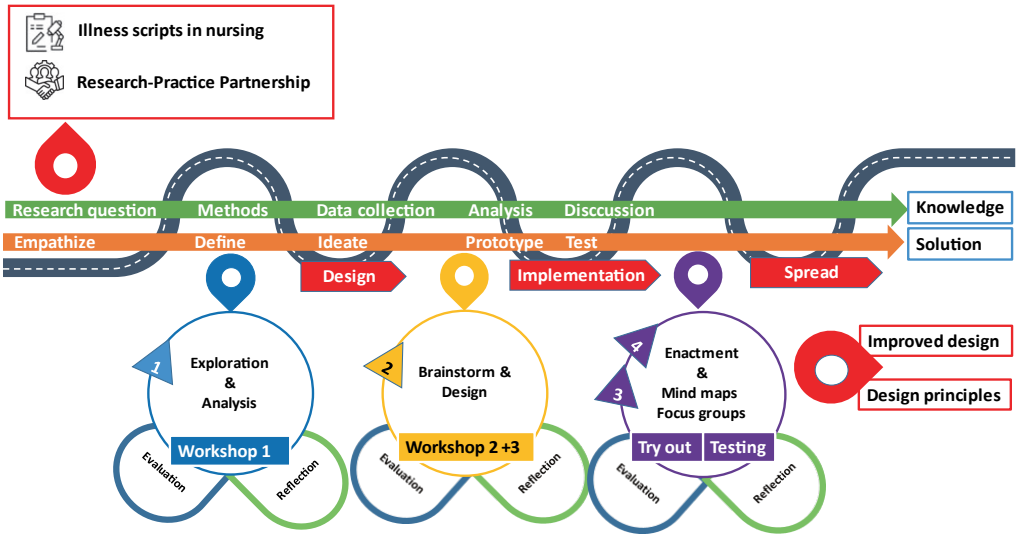

Figure 5.1. Research, design thinking and design-based research (DBR) in cycles.
Green line: usual research process, leading to growth in knowledge.
Orange line: usual design process, leading to a desired solution.
Dark striped line: design-based research process, starting with available knowledge and collaboration, with design and its principles as outcomes. The design-based research approach is cyclic (three circles), and every step is accompanied by evaluation and reflection.

Setting

The study was conducted in two hospitals of a Dutch university medical centre (Amsterdam UMC). Nursing students (bachelor and intermediate level) undergo internships in dedicated educational units (DEU); they provide patient care while coached and supported by nurse supervisors. Certified nurse educators organise and guide 'learning from practice' and supervisors' coaching. The DEU teams (10–18 students) are heterogeneous in experience, length of practice placements (10–40 weeks), study year and education level.

Participants, research–practice partnership and sampling

After information sessions with nurse educators and introductory emails, 15 nurse educators were interested in collaborating. They took part in one or more cycles. The main researcher (JV) is both a colleague nurse educator and investigator. Farrell et al. [43] define a research–practice partnership (RPP) as "a long-term collaboration aimed at educational improvement or equitable transformation through engagement with research". RPPs' benefits are to connect various expertise and promote a design's practical applicability and implementation (21). Students from years 2-4 of the DEUs of participating nurse educators took part (convenience sampling) in cycles 3 and 4.

Design and development

The debriefing procedure was developed through three workshops with nurse educator participants. The first workshop, Exploration and Analysis, focused on building shared awareness of clinical reasoning and illness scripts and collectively describing the problem and context. In the second workshop, Design and Construction, we brainstormed possible solutions for the defined problem: How can we support students in learning from patient experiences with the purpose of building their own illness scripts? The design prerequisites, specifications and the first contours of the solution and design principles were collectively identified. In the third workshop, Objections and Decision-making, the first prototype was discussed, changed and established. The participants formulated four questions based on shared knowledge of illness scripts to provoke the students to verbalise their patient experiences. The debriefing was designed as peer-led with instructions on a pocket card. The supervisor's role was to keep time and intervene when students made mistakes (Figure 5.2.).

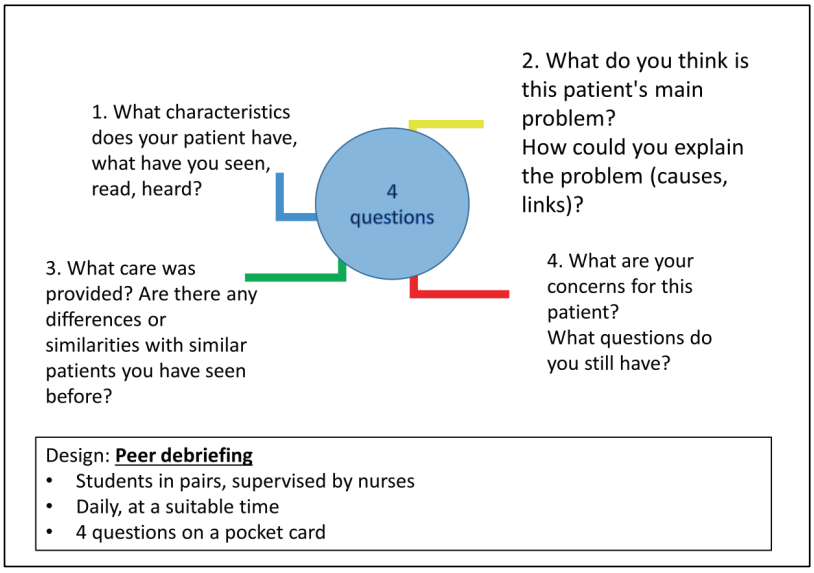

Figure 5.1. Peer debriefing on a hand-held card

Debriefing procedure try-outs and enactment

In the try-out week, 8 units (94 students) participated. They were given instructions, pocket cards, papers and markers for drawing mind maps. The try-out was evaluated positively. No changes were suggested in the procedure. The debriefing procedure was subsequently enacted during 9 weeks on 11 units (118 students).

Evaluation

We used three data types to evaluate the design process, impact and viability: workshops, reflections and evaluations, the research journal, students' mind maps and focus group discussions.

Data collection

The main researcher journaled every idea, step, email, newsletter and reflection. The written assignments, workshop evaluations and reflections were collected. We evaluated the try-out with the participating nurse educators by asking two questions: "What went well?" and "What could be improved?" In the last cycle, we organised five focus group sessions with students (three sessions, facilitated by JV) and the participating nurse educators (two sessions, facilitated by LB) to reflect on the study process and outcomes. The topics included the chosen methods, communication, collaboration, feasibility, viability and any obstacles to institutionalisation (19). The workshops, evaluations and focus group discussions were recorded and transcribed verbatim.

The students were asked to summarise their debriefing of a patient in a mind map during the try-out and the first and last weeks of the enactment. Mind maps present associated concepts, thoughts and information through networks or non-linear diagrams, using verbal and symbolic elements (22). They characteristically have a central theme in the middle, with key ideas as branches connecting words and concepts. The students were instructed by nurse educators, provided with a worked-out example and could choose the mind map design and layout. If the students chose to participate in this study, they could hand in the mind map anonymously.

Data analysis

The data from the focus groups, workshops, evaluations and reflections and the research journal were subjected to iterative thematic analysis (23) to identify and analyse patterns of meaning (24). The provisional themes identified based on the journal and evaluation of the try-out were variation in execution and changing routines. We analysed the focus group data inductively and deductively (JV and LB) to identify patterns in the design process. Accordingly, we familiarised ourselves with the focus group data, generated initial codes and revised and specified the preconceived themes. All themes were finalised in the full research team meeting.

A total of 159 mind maps were collected: 59 in the try-out week, 61 in the first week and 39 in the last enactment week. To analyse mind map differences (25, 26) over time, we developed a literature-based scoring list with quantitative and qualitative items, such as the level of detail, complexity and richness (Appendix 1). JV and CT jointly scored 10 mind maps and another 10 individually. The findings were compared and discussed to calibrate this tool. One researcher (JV) subsequently examined the mind maps, blinded to time, in three steps: every separate mind map, the complete sample of one data point and patterns over the three data points .

Ethics

The Netherlands Association for Medical Education Ethical Review Board approved the study proposal (ERB-NVMO, 222.2.5). We informed nurse educators, students by letter. The participating nurse educators signed a consent form giving permission to use their data from the workshops, evaluations and focus group discussions. The students who handed in mind maps anonymously signed permission to analyse them. The students who participated in the focus groups were asked to sign a consent form giving permission to record and use their data. The participation of students and nurse educators was voluntary and they could leave the study at any time.

Rigour

Korstjens and Moser's qualitative research criteria (27) were applied to ensure the trustworthiness of the draft and this study's conduct. Prolonged engagement (JV has a long-term connection with the problem and context), discussions with the research team and evaluations with the participants in every cycle enhanced credibility. For nine months, field notes, thick descriptions and audit trails were recorded in a journal to promote transferability. In terms of reflexivity, the collaboration dynamics between the researcher and the developers were documented during all cycles and discussed in the focus group sessions.

Results

The design, design process and debriefing impact were evaluated and analysed to advance the principles and optimise the design. The design principles were achieved in part by the findings of the thematic analysis and the mind maps.

Iterative thematic analysis

The preliminary themes, variation in execution and changing routines, gained more depth through analysis of the focus group sessions and completed research journal.

Trigger to reason: The students felt invited to reason audibly and visibly. Even without debriefing questions and procedures, the students assumed they reasoned in their minds. According to the students, not every supervisor can facilitate them in clinical reasoning. The debriefing procedure triggered students to create a logical, in-depth narrative of patient data, such as disease and treatment aspects, and broaden their view to non-medical aspects of nursing care: "*If you went through the steps, you'll get a logical story with depth"* (Student x). *"You'll see things more as a health problem than as an intervention"* (Student y).

Energy giving and taking: The nurse educators were energised by the workshops and appreciated the collaboration with the researcher. "*Thinking along in groups, out of the box, going outside after 2 hours full of energy"* (Nurse educator a). in the fourth cycle it took the nurse educators much energy to motivate students, organise debriefing and change daily practice. As participants, they felt responsible for the investigation's success. "*No pressure, but you almost want to start drawing yourself because you want it to succeed. Pressure comes from myself; JV was very relaxed, for her disruptions come first" (*Nurse educator b). "*This could*

be a great thing, I believe in it, but it takes some work from PO (the team of nurse educators) *to get it embedded"* (Nurse educator c).

The **form follows function** theme captures suggestions to improve the design and assure implementation. The students and nurse educators seemed fuelled by a shared goal: to improve (the teaching of) clinical reasoning. "*Very instructive to ask each other questions and to discuss, to spar, to compare"* (Student w). [We should] "*involve the supervisors"* (Student z, Nurse educator d) to provide insight into the students' learning process and implement regular debriefing. This theme also captures local adjustments to the debriefing procedures and the mind map assignment. For example, some students forgot the instructions and discussed their patients in small groups. The recommendations are incorporated in the design principles as the foundation for a new cycle.

Mind map analysis

Appendix 4 includes the scoring list. The students used a disease, treatment, problem or patient's situation as the central concept. Some answered the four debriefing questions as a map, most used the spider format. The maps had an average 24 items, 12 links and a few crosslinks. Mostly, two levels could be recognised. We operationalised complexity in the completeness of a patient's picture concerning physical, psychological, functional and social issues. The mind maps of the first week of enactment were qualitatively better compared to those collected during the try-out and last week of enactment. In these maps, the students described the chosen concept with more detail and a logical flow, established some form of hierarchy and did justice to the concept's complexity. The mind maps in the try-out had more illness script components: signs and symptoms, epidemiology, management, aetiology, impact and boundary. From the evaluation, we learned that the mind maps were sometimes drawn without prior debriefing, individually or in small groups, and some students used Google to complete the picture. During the try-out, the students were enthusiastic about debriefing and drawing mind maps. In the last week of the enactment, this felt like a burden. The students were then focused on their assessments and less motivated to participate in our study.

Design principles and design

The design principles evolved through the exploration, design and enactment phases accompanied by reflection, evaluation and analysis. The initial principles are more theory-based, the latter more experiential and practical (Table 5.1.).

Initial	1. Students' clinical reasoning competencies can be fostered by facilitating them to organise experiential knowledge and build their illness scripts (9, 10, 28)(Chamberland et al., 2021; Cutrer, Sullivan, & Fleming, 2013, p. 250; Fall et al., 2021). 2. Focused reflection and articulation in debriefing helps learners concentrate on the concrete application of theory to practice and enhance their reasoning skills (29)(Murphy, 2004), fosters restructuring and refining illness scripts (17)(Mamede et al., 2014) and promotes cognitively linking clinical and theoretical knowledge (10)(Chamberland et al., 2021). 3. Participation, co-construction and participant engagement improve the design's feasibility, acceptability and quality (19)(McKenney & Reeves, 2019) and stimulate self-reflection about one's practices, involvement and change (30, 31)(Majgaard, Misfeldt, & Nielsen, 2011; Vallenga, Grypdonck, Hoogwerf, & Tan, 2009).
After three workshops	4. Debriefing must be safe, easy and feasible 5. Debriefing must fit the context. 6. Debriefing must be aimed at learning, not assessing. 7. Debriefing procedures should not place an extra burden on supervisors. 8. To avoid assessment and promote learning, debriefing is structured as peer debriefing among student pairs.
After mind map and thematic analysis	9. Mind maps show organised knowledge and the relationships between findings and can be used as evidence of competency development. 10. Supervisors are actively included in the debriefing procedure. 11. The existing pre-debriefing format/procedure is followed by supervisor-led peer debriefing. 12. Pre-briefing and debriefing are taught as standard educational practices during the students' introduction to practice placement at all units. 13. Debriefing questions should be posed to guide students in perceiving the patient's broader context. 14. Debriefing must be aligned with students' motivation to learn.

Table 5.1. Design principles.

The initial principles (1–3) were derived from the literature and previous investigations. Further practical principles (4–8) were formulated during the workshops. Nurse chose peer debriefing to avoid placing an additional burden on supervisors (principle 7). This principle was contradicted in the later focus group sessions. The current findings suggest that to realise the first two principles, supervisors must play an active role in debriefing.

Based on the suggestions from the focus group sessions and the renewed design principles, the pocket card and debriefing procedure will be adapted for the next school year. Debriefing will be aligned with the existing pre-briefing procedure, in which students

discuss important cues for care prior to meeting their patients. Debriefing will be embedded in the daily evaluations between students and supervisors.

Discussion

Clinical reasoning is complex for supervisors and educators to teach and for students to learn (1, 32). This study aimed to design a debriefing technique suitable for clinical practice that supports nursing students in understanding patient data as a stepping stone to clinical reasoning. The second aim was to generate design principles for developing and introducing debriefing in clinical practice.

Clinical reasoning and debriefing

Experienced nurses are likely to have missed formal training in clinical reasoning offered to students today (33). Moreover, many barriers to the development of clinical reasoning skills among graduated nurses (the supervisors) can be identified (33). Teaching this in practice is not only complex (34), but consensus about the right strategy is lacking (35) and should be adequately included in teacher and supervisor training (32). A common language among professionals, learners and teachers is needed to discuss clinical reasoning (32) and addressing the collaborative aspect of clinical reasoning. Students must learn to deal with two types of knowledge transfer: applying their school-acquired knowledge in different practical contexts and using expertise from one patient for another patient (36). Structured reflection and debriefing encourage relating theoretical knowledge to real patient situations (17, 36-38). Debriefing is based on generative learning theory, according to which learners construct interpretations and inferences by integrating experiences with previously acquired knowledge to build further understanding (15). We used illness script-based questions to structure debriefing, facilitated by a peer, aimed at learning and bridging the gap between experiencing and making sense of the experience by discussing the questions . The questions opened the individual cognitive process for dialogue and provided the necessary language to tell patients' stories and discuss them. The literature about peer-led or teacher-led debriefing is not unanimous (38-40). In our peer debriefing experiment, students could facilitate debriefing, observed by a supervisor, to enhance learning with little stress. According to both the students and nurse educators, supervisors acknowledged their supporting role in developing reasoning skills and they could help implement debriefing in the units' daily schedules.

Generalizability

The large size of a DBR dataset complicates its analysis and reporting. This investigation started with a general problem: How can we support students in learning from patient experiences with the purpose of building their own illness scripts? The outcome of design-based education is typically a local theory – a local solution to a problem (19). Our solution is a debriefing procedure that fits our learning context. Not only is local relatedness an issue in generalising findings, but the concept of causality in educational research and outcome types (41, 42) can also be disputed. In educational research, the interactive dynamics that contribute to the relationship between teaching and learning are at stake (41) – not what works, but how and why it works. We aimed to examine these dynamics in the design process (Figure 1). In Cycle 3 and 4 the students started enthusiastically and debriefing resulted in a broader patient

picture. According to the students, debriefing could compensate for supervisors unable to assist them with clinical reasoning. However, in practice, debriefing did not take place every day; some students forgot the instructions, they had to be motivated by nurse educators, and it was not on the unit's or students' agenda. In short, the actual enactment showed much variety. Nevertheless, the cycles, mind maps and focus group discussions resulted in usable design principles, open to validation by future research. During practice placements, students learn continuously, and it is difficult to differentiate between usual learning and learning with the aid of debriefing. Our findings suggest that a debriefing procedure supports student learning and contributes to building their illness scripts.

Mind maps

This study used mind maps to provide insight into the consequences of debriefing. Mind maps themselves can also influence critical thinking (43) while knowledge is organised into concepts and associations . We found that mind maps are comparable and analysable. They reflected the components of nursing illness scripts, and their quality changed over time.

Motivation

Using debriefing and mind maps to learn and not assess (Design Principle 6) was embraced by all participants. The relationship between motivation to learn and assessment is ambiguous. Assessment might hamper autonomous motivation to learn (44). Conversely, our students missed receiving credits for their drawings. In the last week of enactment, the assessments were considered more important than learning by debriefing and mind maps. Debriefing must be aligned with students' motivation to learn.

Design improvement

A next step is necessary to bring our designed debriefing to full maturity to meet our aims. Based on the design principles, we will re-develop our design (e.g. by bringing the pre-debriefing procedure more in line with the DEUs' practices focused on patient care and learning). We plan to add debriefing as a normal consequence of this procedure.

A second improvement is to introduce debriefing at the start of the internship. Changes in educational tools have to be introduced optimally (Design Principle 12), and not halfway through a 20-week clinical placement. To address student motivation, the relation between learning and debriefing will be explained, supported by general, uniform instructions that are included in the students' digital learning system. Time is a factor in implementation. Our try-out lasted a week and the enactment spanned 9. Generally, more time is needed to change group attitudes or behaviours. All the participants concluded that real change did not happen during the research period, even though all nurse educators remained enthusiastic and implementation of the new procedure was not very demanding.

This discovery leads to a new research question: How can nurse educators effect sustainable change while implementing new educational tools in hospital practice? We will address this question in a future study.

Conclusions

Clinical reasoning is hard to learn and to teach. This design-based investigation displays how nurse educators can design and implement a debriefing procedure to facilitate students' clinical reasoning skills and how students can reap the benefits. This method integrates research, innovation and collaboration. The design and enactment under real-life hospital conditions generated design principles for educators and researchers seeking to improve teaching and learning clinical reasoning in practice. More clarification is needed about the path from design through enactment to real change in practice.

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Chapter 6
Design-based research is only half the battle for an educational in clinical practice

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Submitted as a perspective paper

Abstract

Introduction: Although design-based research (DBR) is conducted with the idea of bridging the theory/practice gap, we perceived a gap between design, enactment and sustainable change. We assume that context—particularly routines—plays a decisive role in this gap.

Objective: This study aimed to explore the appropriateness of using a DBR approach in inducing change by exploring the research question: *How can implementing new learning tools in hospital practice lead to sustainable change?*

Approach: In this work, we present our DBR experiences as a case study. Thereafter, we explored theories about practice, routines and routine dynamics. The identified elements of routine dynamics are then related to our context, findings and experiences.

Discussion: From the case data, an eye-opening insight emerged. Context, especially the prevailing routines and new routines to be developed in this context, are significant constituents in all phases of DBR. Furthermore, elements of routine dynamics can explain the variance in enactment and the difficulties involved in establishing a new educational routine in nursing clinical practice.

Introduction

One of the intentions as well as assumptions of design-based research (DBR) is that it is a bridge between theory and practice. DBR in education was first introduced in 2002 (3) with the aim of developing learning theories by designing educational interventions (4, 5). Three phases can be identified in a DBR process: 1) analysis and exploration, 2) design and construction and 3) implementation and evaluation. DBR is an iterative process accompanied by reflection and evaluation. In this article, experiences with DBR in clinical practice are presented. Halfway through a DBR trajectory in our research, we found a new thread in the data for a new audience with a new research question (6). The new thread is the experienced gap, which indicates that more efforts are needed to bridge the distance between the design, its intentions and principles on the one hand, and the actual changes in a new educational routine within a complex context on the other.

Daily routines dominate nursing clinical education in hospitals. The literature confirms that routines have a great influence on clinical practice and its dynamics (7, 8), such that the designed solution or intervention may not be accepted if these routines are not considered. Hence, the current article aims to explore the appropriateness of DBR in inducing change and to explore what is known in the literature about changing routines in the workplace. This article also aims to match these explorations with our findings based on the cyclic reflections and evaluations during the original research process. The guiding question is as follows: *How can implementing new learning tools in hospital practice lead to sustainable change?* To answer this question, we begin by presenting our DBR experiences of debriefing in clinical nursing practice, as shown in Figure 6.1. Subsequently, theories about practice, routines and routine dynamics are explored. Then, elements of routine dynamics are further elaborated upon and laid alongside our findings and experiences. The article concludes with reflections and discussions on the research process, the setting and possible implications. Specifically, we argue for a more rigorous inclusion of context in all phases of a DBR research protocol, including the prevailing routine dynamics, to meet the abovementioned assumption, the bridging of the gap between theory and practice through research.

Our research on 'Debriefing in clinical education' as a case

Inspired by illness script theory (1) and research on illness scripts in nursing (2), a debriefing format to enhance clinical reasoning was developed, tried and tested through the three design-based research (DBR) phases. The investigation took place in two Dutch academic hospitals, where nursing students (12–18) were placed on Dedicated Educational Units for 5–30 weeks. The students learned 'by doing' while being coached by nurses or so-called supervisors. The teaching and learning activities on every unit were supported by a nurse educator. The first author collaborated with her nurse educator colleagues. Three workshops took place during the two phases of analysis and exploration and design and construction. The workshops aimed to create awareness, discuss the practical problem, design, energise and empower. This approach was intended to ensure the quality and practical applicability of a designed solution and to facilitate easier implementation (3). The designed solution was a daily peer debriefing procedure done in pairs on clinical reasoning and illness scripts, which was developed during that day while caring for patients, supervised by nurses and structured by four questions. The debriefing procedure was carried out, enacted and evaluated with mind maps and focus group discussions.

During the nine months of DBR, qualitative data were collected from various sources, including results of workshop assignments, workshop evaluations and reflections, transcriptions of workshops, presentations, a research journal, evaluations and focus group discussions. We identified two preliminary themes, variation and routines, during the two enactment cycles in the phase of implementation and evaluation. These themes led to the a second research question: "How can implementing new learning tools in hospital practice lead to sustainable change?" For the formal analysis of the collected data, we used iterative thematic analysis (an adaption of thematic analysis), through which preconceived themes and initial beliefs have a function in the analysis. The data were coded by the main researcher and the research assistant, who transcribed all audio data. We found four themes, all related to inducing changes in (educational and caring) routines on a hospital unit.

***Theme 1: Living in different realities**. The students are both focused on their own student team, on the unit supervisors and on the tasks of learning and caring. They appreciate the good atmosphere amongst students and supervisors, but shared a common sentiment summed up by one student: 'We have to do a lot, which sometimes gets in the way of my learning process' (Student 1). The nurse educators see the unit as a field to be cultivated to enhance growth in students. The dynamics in a student team, the expectations and skills of the supervisors and their own expertise are perceived as given: 'In our case, students and supervisors encouraged debriefing' (Educator a). Students sometimes have other priorities than learning, such as providing patient care or preparing for assessments. **Theme 2: Information and instruction seep away**. The nurse educators summarised the informed consent letters, wrote emails and introduced the new procedure to the student team and the team of supervisors. Involvement in the research project facilitated communication for the educators, but written instructions were not read according to the educators, and students and supervisors were not always present during presentations (e.g. 'I did not hear about [the] debriefing' (Student 2), and 'The information has vanished' (Student 3). **Theme 3: Role uncertainty**. In particular, the nurse educators observed the motivation of students and their supervisors to debrief as a challenge ('Should I cheerlead?' (Educator b). Some students only debriefed when the nurse educator was present at the unit. The organization of debriefing at the unit was not easy ('Did I do enough?' (Educator c), 'It was not entirely clear to me what was expected of us' (Educator d)). Nurse educators can either demand or employ a 'laissez faire' approach. They were convinced that students themselves should show initiative to debrief. The students wanted to know if they are allowed to take time to learn and to perform learning activities outside of direct patient care or mandatory assignments ('Leaving care is difficult' (Student 4)). **Theme 4: Variation and alternatives**. The developed intervention and procedure underwent many changes when enacted. We experimented with finding the right time for debriefing, which did or did not take place. Students preferred to work in small groups instead of pairs. Debriefing took place in educator-led teaching sessions, debriefing was not used to articulate the story obtained from the patient, but to check information via Google, etc.*

Figure 6.1. The DBR debriefing case

Practice, routines and routine dynamics

For the purpose of change or successful implementation, greater awareness of the dynamics of the workplace learning environment, the practice, is needed. In this situation, 'practice' refers to purposeful actions, often based on habitual reactions (9) on clinical demands. Introducing new procedures in nursing is tough, as nursing teams tend to maintain or strengthen an existing situation (7, 10). For example, performing the auscultation technique to verify nasogastric tube placement is known to be quite risky. In fact, auscultation has been forbidden in the Netherlands since 2017. Although the required pH measurement is instructed in the guidelines, nevertheless, nurses find it hard to change, to trust new procedures and to abandon what was once learned (11, 12). If changes to directly reduce risks in patient care are difficult to accomplish, what does that mean for changes to improve the learning of nursing students? Fuelled by our findings (Figure 6.1.), information to explain this willingness or unwillingness to change phenomenon was sought in the literature on routines in practice.

The sociologist Bourdieu studied practice as a social activity within social structures (13). In his explanation of why reproduction of a current situation is more probable than transformation, he identified three interrelated determining concepts of practice: 'field', 'habitus' and 'power' or 'capital' (9, 14). The field is a structured social space in which individuals and groups perform, interact and deal with events. The field is also an arena of relations and forces. Fields can overlap or contrast, similar to our case, where education and care also overlap (9, 14). The habitus in a field is a product of history—a constellation of social conventions, agreements and assumptions that regulate the usual practices. It combines individual and collective patterns of thought, attitudes and performances, either to preserve or to change (9, 13, 14). Furthermore, habitus is obvious and is outside of the awareness or language to describe (15). It is also dynamic as it transforms explicit and tacit knowledge through activities (16). 'Power' is defined as the ability to initiate actions or maintain a situation (17). According to Bourdieu (13), power is the ability or capacity to have access to resources. In his later work, he refers to political, financial and symbolic power as 'capital' (14). Habitus and power define a current practice and, above all, maintain it.

This idea is further studied in the area of knowledge of routine dynamics (18). Routine dynamics are investigated to explain changes, patterns and variations. Here, 'routines' refer to repeated (patterns of) action, expressions and agency, which are executed by several actors, inextricably interrelated with the situation, the structure and the materials at hand (19, 20). The routines of organisations can be considered habitus (16). (Dis)Order, (un)certainty, complexity and (in)stability are the reasons for the existence of some routines. They are dynamic because routines adapt over time and place. Hence, routines and their internal dynamics contribute to both stability and change in organisations (20). The influential elements of routines are depicted in Figure 6.2.

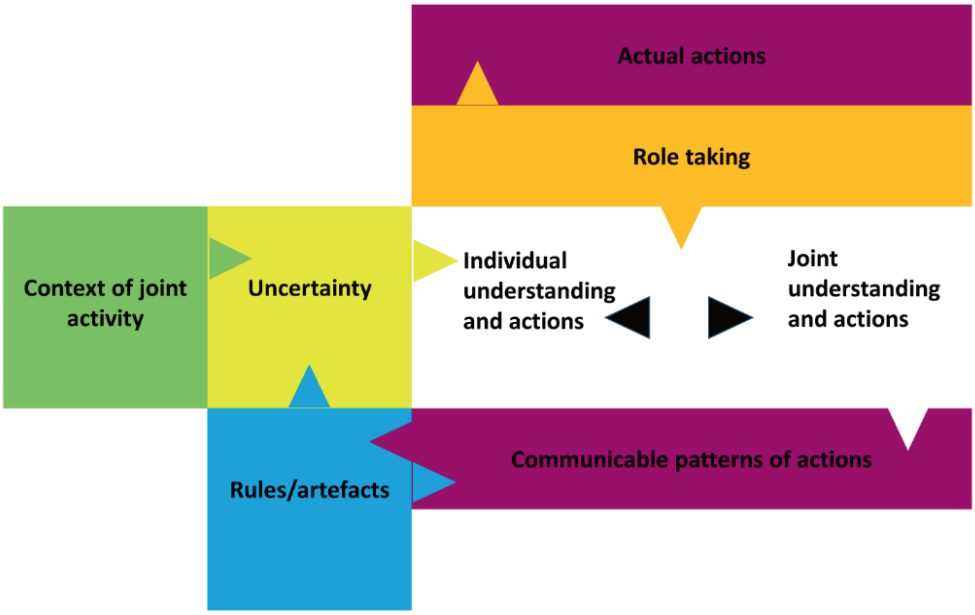

Figure 6.2. Routine dynamics and its elements, based on Dionysiou and Tsoukas (2013): Context, rules and artefacts all lead to uncertainty. These three elements combined provoke interacting individual and joint explanations and actions. Actions take place through role taking. Furthermore, communicable patterns of actions are realised through the generalisation of interacting individual and joint explanations and actions combined with rules and artefacts.

Routines can be viewed as a collection of microprocesses (elements) and relations (21). Several notions play a role in routine dynamics. Routines are situated in a context ((a segment of) a field) and are a consequence of a) the context of joint activity with a common goal; b) uncertainty; and c) rules, materials and policies (described as 'artefacts'). The actors are individuals and interacting small groups. Here, the actual behaviours of individuals or in joint activity in interaction (actual actions) are contrasted with shared, structured patterns of actions (communicable patterns of actions) (18, 21).

Participants of different subgroups may have different understandings of a routine based on their own perspectives. It takes effort, energy and resources to produce a new, shared pattern of actions and to 'turn novelty into familiarity' (21*)*. At the same time, to enact a routine is to create an occasion for variety, because humans, rules and artefacts change as the routine is performed. This variation does not necessarily mean 'change'. Actual actions and communicable patterns of actions interact reciprocally; the actions create and recreate the patterns, which in turn, constrain and enable the actions. From routine dynamics, we learn that to induce change, a new intervention (rules/artefacts) is merely one element. The other elements in Figure 2 may contribute as much to change.

Context of joint activity: Workplace learning in the hospital

The clinical teaching of nursing students is largely based on workplace learning: 'Learning at work, through work and for work' (22). It takes place in different care settings for different patient groups. Workplace learning in nursing is a kind of collaborative learning that

is based on relationships with supervising nurses and peers. Students learn experientially through observation, participation and reflection, as they develop their identity as nurses and become valued members of the nursing team (23-25). The clinical setting in which our investigation was conducted is a difficult setting for students. They have to master a broad variety of nursing activities for several patients, in unpredictable situations, with many other caretakers, with a lot of information and under time pressure, all while considering safety issues (26, 27). The process of learning and teaching interacts with these clinical complexities. Workplace learning is situational (28), and the student, patient, supervisor, team and organisation, along with the collaboration between supervisors, faculty and nursing educators, all influence workplace learning. Together, they form the learning and teaching ecology. Ecologies are 'complex systems of interactions among instructors, students and environmental components' (29). The complexity of this environment contributes to uncertainty and routine dynamics.

Rules and artefacts

The rules and artefacts in the figure can either be new or a consequence of communicable actions. In general, rules and artefacts are policies, decisions or procedures. Laws or regulations are not intended by this element. In our case, nurse educators designed a procedure and provided instructions, communications and a handheld card. In the data analysis, we found that information about the intended debriefing procedure leaked away, was forgotten or did not reach students and supervisors (Theme 2, 'Information and instruction seep away').

Joint and individual understanding and actions

The context of workplace learning houses different participants with varied interests, based on competing realities, such as patient-centred care, managing and learning/teaching (30). The participants also differed in terms of influence and authority. In nursing, habits, routines and rules are valued as functional; they enhance stability and order in everyday activities (7). The culture of a unit, which connects individual and joint behaviours (7), can explain the success of change trajectories. The culture of a unit or team can be characterised with the aid of Quin's competing values framework (7, 31, 32). In this framework, the competing values are placed on two axes: control–flexibility and internal–external focus. Teams may emphasise team attributes, such as belonging, trust, growth, experimenting, competition, achievement, stability or hierarchies, all of which are plotted on these axes.

In team cultures, different values about change can flourish, including routine seeking, change as a stress factor, cognitive rigidity and short-term focus thinking (7). Efficient and collaborative management can influence these behaviours to either maintain or change routines, along with nurse leadership, which is a broader concept for all nurses. Through leadership, including networking, coalition building or persuasion, competing realities can be transformed into a collective goal (30). In the element of joint and individual understanding and actions, the first identified theme ('living in different realities') can be recognised.

In this article, we chose the DBR approach to enhance successful, sustainable implementation. To realise change, solid interventions, ownership, involvement and knowledge about the participants are essential (4). The workplace learning context, the competing realities and values of participants and cultural attitudes seem to be as important. They have to be explored in the first phase of DBR, incorporated in the design and taken into account in the implementation and analysis of the evaluation.

Role taking and uncertainty

'Role taking' refers to the alignment of behaviour with the expectations of a specific role (33). In routine dynamics, this aims to develop a joint understanding of a situation (21). The subgroups in our study are nursing students, supervisors and the nurse educators of a hospital unit. They are surrounded by patients, managers, doctors and many others not included in this exploration. Each of these subgroups may have a different understanding of the current situation or the goals of the routines, such as learning, caring and teaching.

For students, the role they perceive to play depends on the learning values of the nursing team. The interaction between students and supervisors may take the form of collaboration between partners, or the students might consider themselves as visitors/learners and the supervisor as a guide/mentor. In turn, supervisors may protect or monitor students when providing care. If the students show that they know the routines, they might gain access to the nursing team and be given more opportunities to learn. Thus, competing learning climates can be based on partnership or on negotiation and conditional membership (24). This, in turn, influences the role taking of students and supervisors. This is also why students and supervisors conceptualise clinical learning in either a broader or a narrower sense. In a narrow understanding, students tick off their (formal) learning goals to obtain permission from supervisors to grow in independent caring. In the broader view, students are invited by supervisors to reflect and gain an understanding of oneself, the patients and the system to grow in responsibility (34). Both the characteristics of learning climate and clinical learning conceptions shape the expectations and role taking of students and supervisors.

The role of the clinical nurse educator is to facilitate, organise, coach, innovate and assess clinical learning (35). They aim to improve the quality of students' learning and ultimately enhance the quality of patient care. They build bridges between schools and practice, between experience and theory and between the learning needs of individual students and the needs of both the student team and the team of nursing supervisors (36). To do so, they often seek a balance between a facilitating, moving along and demanding attitude.

Thus, all participants have an idea how to act individually in accordance with their roles and what their potential contributions might be in joint activities (21). In this setting, conflicting interests and power dynamics cannot be ignored (24). Power can be viewed as power to control (suitable for a position) or power to influence, based on skills, expertise or access to resources (21). The student and the nurse educator have no positional power in the clinical learning situation. As a result of such imbalance in power, students may presume what

behaviour will be appreciated by their supervisors and act accordingly to gain positive feedback from them (17). Educators weigh the use of their influential power, based on expertise and interpersonal skills, in the conflicting areas of care and education (37).

Role taking and power are components that bring about change or maintain a situation as it is. For DBR used in clinical education, this means that learning climate, conceptions of learning, roles/role taking and power or influence must be explored and expressed in the design prerequisites. In other words, they are the conditions for design, implementation and evaluation. In our analysis, we found uncertainties related to role taking (Theme 3, 'Role uncertainty').

Actual actions and communicable actions

A routine is shaped by repeated actual actions and their generalisation into shared schemas. Furthermore, a routine is a way of dealing with uncertainty and a means of bringing order in complex environments. Through understanding, actions and role taking, an iterative relationship develops between actual and communicable patterns of actions. This relationship, fuelled by rules and artefacts, context, uncertainties and role taking, is used to explain the stability of routines and the difficulties involved in changing them (20). The same process can lead to variations in actions, and this variety can be explained by the differences in understanding, in responses to uncertainties and in the perceived context and role taking (21).

In our case, a new routine (i.e. daily debriefing) needed to emerge within many known and unconscious routines of individuals and groups of students, supervisors and nurse educators. The successful enactment of a new rule or artefact has to pass many stations (the elements in the figure) to result in a new routine, and even then, 'Each time a routine is enacted is an occasion for variation' (20). These characteristics of routine dynamics are reflected in Theme 4 ('Variation and alternatives').

Reflection and discussion

There is a conviction that context is crucial, especially the prevailing routines and new routines to be developed in the context. This conviction is based on the data of the case described. The preliminary themes of variety and change in routines steered us to the theory of practice and routine dynamics.

As suggested by McKenney and Reeves (38), in the DBR process, we analysed the context in the workshops: the material, organisational and educational aspects of the workplaces and the possible hurdles that hindered our process. The drawn design requirements were based on this analysis. Consequently, we developed a peer debriefing procedure with four questions that would take little time at flexible moments without additional burdens for the busy supervisors. During the project, although we met no opponents, real change was difficult to realise. In this article, we investigated whether a framework of routine dynamics can explain the difficulties involved in realising change in practice. The themes obtained in the case study could be mapped in the routine dynamics. *Living in different realities* gives meaning to the context and to both joint and individual understandings and actions. *Role uncertainty* connects

uncertainty to role taking and power, while *information and instruction seeps away* accompanied the designed new rules and artefacts (the debriefing procedure). Finally, *variation and alternatives* are explained in the iterative relationship between actual actions and communicable actions based on all elements of routine dynamics shown in Figure 6.2.

Clinical workplaces are the arena of conflicting worlds of caring, teaching and learning, and each unit has its specific culture, attitudes to change, goals, realities, understandings and actions. The habitus, specifically the routines, are influenced by power and role taking. 'To leave everything as it is' is a normal consequence of teams and organisations' survival mechanism. We learned from the literature that in the three phases of DBR (analysis, design and implementation and evaluation), the exploration of routines and their dynamics has to find a place in them.

DBR intends to bridge the gap between theory and practice (4). If 'practice' here refers to the clinical education environment, then this bridge needs an extra pillar: the routines of the context. Based on our findings, context and routines are crucial in all three phases of DBR. For example, in the exploration and analysis phase, the competing values and different realities of all stakeholders of a unit must be considered, along with the ways in which routines are valued and established. The brainstorm and design phase should include the instructability of the design and the appropriate communication channels to use. The role expectations and leadership of nurse educators, supervisors and the unit management must be included in the design. Continuous information, discussions about understandings and leadership are needed in the implementation and testing phase. Change might be supported by the management and nurse educators reconciling the different realities of students and supervisors (30). We recommend embracing the doubtless variations that participants bring into the design, as this gives participants the opportunity to influence (10).

This brings us to our last point. Given that interventions (the design) are enacted amidst the complexities of real-world clinical practices (29), variance in understanding and actions must be considered. This, in turn, leads to difficulties in assessing the success of an innovation and the viability of change. Viewing innovations as a change in educational routines might help explain these findings. The inclusion of routine dynamics in the DBR research protocol is a necessary addition to ensure the successful design and implementation of a new educational tool in clinical practice.

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Chapter 7
General discussion

Introduction

Clinical reasoning is a crucial competency for nursing students to develop. In this thesis, we aimed to improve the teaching of clinical reasoning of nursing students in practice for the benefit of patients. To provide a sound knowledge base, we chose the educational design approach, in which objectives, content, teaching and testing must be aligned. The objectives of a clinical reasoning educational programme can be informed by the investigation of the conceptualization of clinical reasoning among experienced nurses. To this end, we compared and contrasted what is written about clinical reasoning of professionals in the medical and nursing literature (Chapter 2). Then, to be able to specify the content of reasoning better, we pursued to gain more understanding about the shaping of experiential knowledge in experienced nurses. We conducted an interview study among expert nurses, followed by directed content analysis (Chapter 3). As a next step, we investigated if and how the development of clinical reasoning can be assessed. We conducted an instrument design study (Chapter 4). And lastly, we studied with a design-based research (DBR) approach if debriefing in a practice setting can contribute to teaching clinical reasoning (Chapter 5). We experienced that even with DBR, which is conducted under the assumption of bridging the theory-practice gap, implementation of an innovation in clinical practice is difficult due to routines and their dynamics. We wrote a perspective paper based on our reflections on DBR and implementation (Chapter 6).

The empirical research of this thesis is conducted in the clinical teaching setting of two large university hospitals in the Netherlands.

Throughout the thesis we have used the definition of clinical reasoning by Simmons. Clinical reasoning is, "*a complex process that uses cognition, metacognition and discipline-specific knowledge to gather and analyse patient information, evaluate its significance, and weigh alternative actions"* (1).

Two of our studies build on medical investigations into illness scripts. Illness scripts are organized knowledge structures in long term memory. In these scripts general knowledge of diseases is linked to actual patient care experiences. Illness scripts comprise knowledge components. Originally, three components were identified in physicians: signs and symptoms, fault, and enabling conditions (2-5). Illness script theory involves the script as a concept as well as the development of expertise, from novice to expert (6, 7).

In the introduction we referred to the generic didactic model to design education (van Gelder's model, described in) (8). Based on the research in this thesis, this model (figure 7.1.) can be specified for the education of clinical reasoning in clinical practice. We proposed to enhance the original model with the three learning theories. We found that situativity, along with the skills acquisition model and self-regulated learning is the foundation of clinical education development. The four yellow diamonds are our contributions to the

development of clinical teaching of nursing reasoning. These can be applied and developed further.

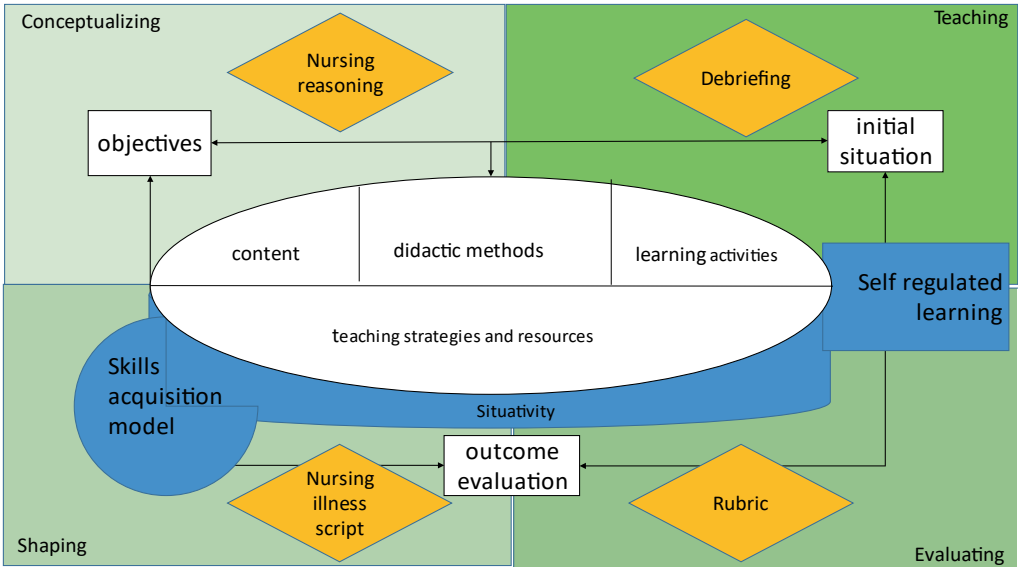
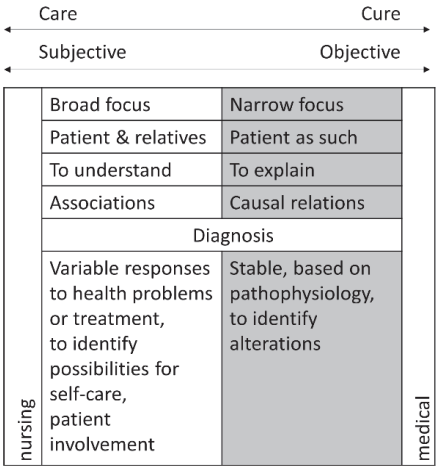


Figure 7.1. The thesis incorporated in the didactic model (8). In green the four themes of the thesis are depicted, in blue the learning theories, in white the original model and in yellow the specifics of clinical reasoning education.

In this general discussion the main findings are discussed, first ordered by the four themes. Subsequently the main findings are discussed on the basis of three learning theories. This discussion of findings leads to new questions for further research. In the paragraph, 'Actionable knowledge', the practical value of the thesis is discussed, along with implications and recommendations.

The main findings of this thesis are summarized in table 7.1.

	Chapter	Research question, objectives	Main findings
Conceptualizing	*Chapter 2* Reasoning like a doctor or like a nurse? A systematic integrative review 2A The protocol 2B The review	What are the features of clinical reasoning of professional practitioners as described in the medical and nursing scientific literature and what can we learn about clinical reasoning from this simultaneous concept analysis?	◦ We developed an onion model of clinical reasoning aspects, compiled from concept and layered analysis ◦ The main differences we found between medical and nursing reasoning were 2 continuums, 4 contrasts and the concept of diagnosis.  ◦ Medical and nursing reasoning is described as an individual process, but increasingly as a collaborative, team process
Shaping	*Chapter 3* Illness scripts in nursing: Directed content analysis	How well does illness script theory describe nurses' experience-based knowledge?	◦ Illness scripts can also be identified in nursing, and are comparable to those of doctors ◦ Nursing illness scripts add impact, boundary, occurrence and explicative statements to the medical illness script components (signs and symptoms, fault, enabling conditions and management)

	Chapter	Research question, objectives	◦ Main findings
Evaluating	*Chapter 4* Development and validation of Dutch version of Lasater Clinical Judgment Rubric in hospital practice: An instrument	To obtain a Dutch version of Lasatar Clinical Judgment Rubric and to test its psychometric properties on nursing students during their hospital traineeship	◦ A rubric was adapted and its measurement was validated in the hospital setting to evaluate the development of clinical reasoning in nursing students
Teaching	*Chapter 5* Debriefing to nurture clinical reasoning in nursing students: A design–based research study	How can we foster students to organize their experiential knowledge of patients through a debriefing procedure in clinical practice? Which supportive design principles can be distinguished from the design development process?	◦ Structured peer-led debriefing triggers reasoning in nursing students ◦ The mind maps made by nursing students showed illness script components ◦ The mind maps showed differences in quality over time (complexity, logical flow, hierarchy, level of detail) ◦ Nurse educators were energized through participation; enactment cost them energy ◦ There was variety in enactment of debriefing and producing mind maps ◦ Better use of context is needed to fully implement debriefing on the dedicated educational units
	Chapter 6 Design-based research is only half the battle for an educational solution in	How can implementing new learning tools in hospital practice lead to sustainable change?	◦ Variance in enactment of an educational innovation in clinical practice can be explained by routine dynamics ◦ Routines and the elements that shape routines are significant constituents in all phases of design-based research and must be incorporated in the research and implementation protocol

Table 7.1. An overview of the main findings of this thesis

Conceptualizing clinical reasoning in nursing

How can clinical reasoning be understood?

We aimed to compare and contrast medical and nursing literature on clinical reasoning, to learn more about nursing reasoning. We chose the integrative review method (9), because this stepwise method includes the full spectrum of scientific publications. The protocol of this review has been reviewed and published (10). Sixty nine articles were selected for analysis. The simultaneous analysis of clinical reasoning of nurses and doctors was inspired by two practices to analyse and construct: concept analysis of Walker and Avant (11) and layered analysis of an educational intervention (12). Based on these, an onion model was developed to study the retrieved literature, to get to the core of clinical reasoning (figure 7.2.). The eight onion shells guided data extraction, and further summarizing and arrangement of these data led to a structure of three layers, eight shells and thirty-eight cells (table 7.2., the summary of nursing reasoning, appendix 3 validity matrices).

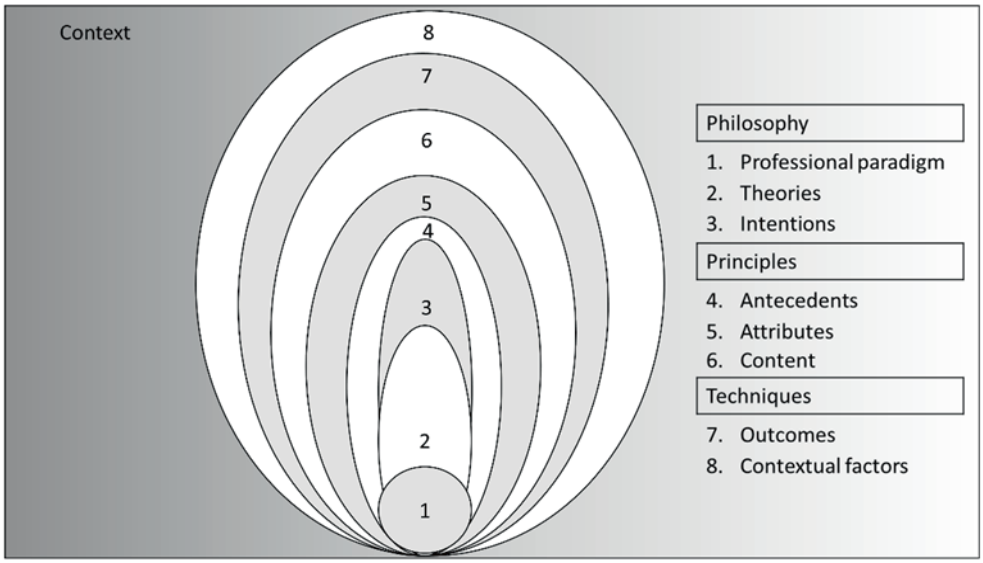


Figure 7.2. Onion model to analyse symbolizes the multi layered approach in data extraction and the subsequent comparison. The core is the philosophical layer, influencing the layer of principles (the structural aspects of reasoning) and the layer of techniques (the visible aspects of reasoning) (12).

The onion model makes a complex concept accessible, and might be useful for alignment in collaboration in patient care, education and research. Comparing the medical and nursing literature we found commonalities and differences, which helped us to conceptualize nursing reasoning.

In particular, the visions on nursing, the paradigm, and the outcomes define nursing reasoning. The patient takes a special place in nursing reasoning (13, 14). Preferably, the patient is involved, his personal information is needed to reach a nursing diagnosis and set up a treatment plan. An established relation between patient and nurse is considered an antecedent, something that precedes, as is expressed by knowing the patient (15), or mutual trust (16). Despite this finding from the literature, in our next study (17), we found that nurses also have memorized scripts, which enable them to care for new patients, who are not yet well-known by the nurses.

'The patient' in nursing could also be a patient along with his significant others, or a family (18, 19). Often the focus of nursing reasoning is also the disease, or the needs of the patient, but nurses involve the broader situation in reasoning like daily functioning or quality of life. A holistic, subjective understanding of the patient is significant for nurses (20, 21). So, 'knowing the patient', as described in Chapter 1, is an important element in nursing reasoning.

In nursing, diagnosing is an ongoing process. The aim of a nursing diagnosis is to identify a current situation, including the risks, the responses of a patient and his relatives to health problems and to the treatment (22-24). Recently, more studies are published on management reasoning of health professionals (25, 26). This is also a more dynamic type of reasoning than medical diagnostic reasoning, involving patients' preferences, the environment and the larger care team.

Moreover, we found many studies which considered clinical reasoning as mental processes happening within individuals. In the current interprofessional practices in care teams, the situative (environmental) and collaborative aspects of reasoning come more to the fore (27, 28).

Nurses, especially those who are additionally trained, learn also to reason to reach medical diagnoses (29). We can argue that medical reasoning *and* nursing reasoning are both essential for good patient care.

Our findings on the differences between nursing and medical reasoning have been recently supported in an empirical study by Huesmann et al. (30). They interviewed physicians, nurses and medical and nursing students. They added the barriers in clinical reasoning, like time or need for education.

According to our findings, nursing clinical reasoning is determined by many aspects, as is shown in table 7.2., and more elaborate in appendix 3.

Contribution to educational design model

Our findings can be used to formulate objectives (intended behavior, knowledge and skills) for a clinical reasoning programme. For example, a learning objective might be: *'the student can explain how subjective and objective data from a patient complement each other in reaching a diagnosis'.*

Table 7.2. Summary of nursing reasoning

Philosophy			**Principles**			**Techniques**		**Layers**
Paradigm	*Theories*	*Intentions*	*Content*	*Antecedents*	*Attributes*	*Outcomes*	*Contextual factors*	**Shells**
· Care-cure continuum · Subjective-objective knowing continuum · Patient involvement in reasoning	Theories on: · Memory and cognition · Rationality, intuition and analysis · Perception and interaction	· To diagnose or assess · To understand and explain · To achieve improvement · Patient management · To enlarge knowledge · To collaborate	· Focus · Clientele	· Experience · Triggers · Task characteristics · Nurse characteristics · Knowledge · Relations	· Use of cognition, memory, perception, attention, recognition, intuition · Data analysis and interpretation · Generation of hypotheses or alternatives · Cognitive strategies, heuristics, inferences and approaches · Reasoning as a process	· Diagnosis · Management · Collaboration · Explanation · Decisions · Prognosis · Judgment · New knowledge	· Environment	**Cells**

How is expertise of experienced nurses organized?

In the review, illness scripts were mentioned in the underpinning theories on memory and cognition, how information is perceived, processed and stored (31-33). Illness scripts can be viewed as a prerequisite to clinical reasoning (34, 35), they were mentioned in the antecedents referring to knowledge. Illness scripts were also mentioned as attributes, when describing the use of cognition, memory perception, attention, recognition, intuition and in data analysis and interpretation (35-37) (table 7.1., appendix 3). Hence, we aimed to explore if the concept of illness scripts, which has been investigated in medicine, can also be established in nursing.

Through a think aloud interview study, among expert nurses, about patient problems, analyzed with directed content analysis, we were able to produce a nursing illness script model (figure 7.3).

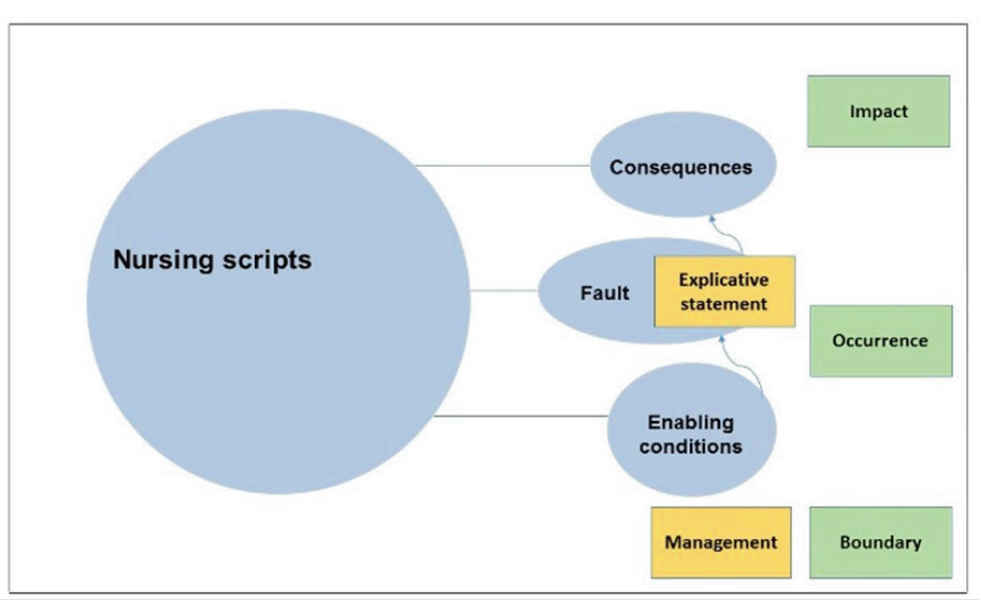


Figure 7.3. Nursing script. The blue items represent the original model (5), the yellow items were added in previous investigations (38, 39), the green items are additions that we made for nursing.

We found that, when expert nurses talk about patient problems, they had a rich memory of *signs and symptoms*, which enables nurses to recognize a typical situation more quickly and the perceived sign and symptoms trigger clinical reasoning (40). The nurses could also reproduce many *management* statements, like 'always encourage getting out of bed'. A large proportion of management statements in the interviews may indicate expertise (39). *Enabling conditions knowledge*, non-medical background information including

epidemiological factors, is shaped through experience. This knowledge is related to early problem identification, and a rich memory of enabling conditions is considered a characteristic of medical experts (41, 42). The expert nurse in this study reported fewer enabling conditions, like age or length of hospital stay, than expected.

In our model (Figure 7.3), context is represented by *occurrence,* statements about the prevalence of a problem and *boundary,* the limits of nursing activities. Van Schaik et al. (43) have already suggested to incorporate context, for example the work environment, into medical illness scripts. More recently, Witti et al. (44) described an internal collaboration script, referring to knowledge about collaboration procedures. The *impact* component reflects the nurses' involvement with the patient, to know them as a person, and the premise that nursing is about responses to health problems, as also found in our review. 'If someone is in pain, he is obstructed in carrying out all activities' and 'so that was very difficult to deal with as a team', are quotes of these two types of impact. These 'nursing' components situate the illness scripts in the workplace environment.

Because not every patient problem, such as psychological problems (38) can be explained by causal, pathophysiological mechanisms we added *explicative statements* to the *fault* component. Many patient problems we inquired about have several origins. E.g. In our review, we found that nurses use many *explicative statements,* associative relations, to explain the existence of a problem and not the cause.

Knowledge about Illness scripts is applied and studied in formal education (45-47). In these examples, illness scripts are used, as a format, to structure disease information of a case. Illness scripts were also used in the development of a specific clinical reasoning test: the Script Concordance test (4). In addition, it is described that if the illness script model is transformed into clinical teaching tools, that students might better cope with the cognitive overload during hospital practice placements (48). This idea was investigated in the debriefing study (chapter 5).

Besides illness scripts as a concept, the illness script theory also describes the development of expertise, the differences between novices, experienced and expert professionals (7). This aspect has yet to be considered in nursing and could be a question for future research.

Contribution to educational design model

The knowledge of illness scripts in nursing can be used to determine the content of a clinical reasoning programme, e.g., teaching more about *signs and symptoms* and *enabling conditions* (background and epidemiological information) in order to facilitate recognition of patients' situations for the students.

Evaluating clinical reasoning in nursing

How can growing expertise in clinical reasoning be evaluated?

To answer this question, we conducted an instrument design study. In teaching, evaluating or assessing the development or change initiated by an (educational)

intervention, is required. Two purposes of assessment can be identified: assessment 'for' learning and assessment 'of' learning (49-51). Although the trigger to start this investigation was the desire to have an outcome measure for clinical reasoning, we were more interested in an assessment that would be informative about the process of learning for the student as well as the assessor, i.e. a formative evaluation tool.

Lasater (52) expressed the need for an evaluative instrument in evaluating clinical reasoning (or judgment): a standard language is needed to facilitate communication and feedback and to inform students what is expected from them. She assumed that a rubric provides this language, for supervisor feedback and directions for development to students (53). The Lasater's Clinical Judgment Rubric (LCJR) is based on the four phases of Tanner's model, 'Thinking like a nurse' (clinical judgment model): noticing, interpreting, responding and reflecting (Figure 7.4.) (52, 54).

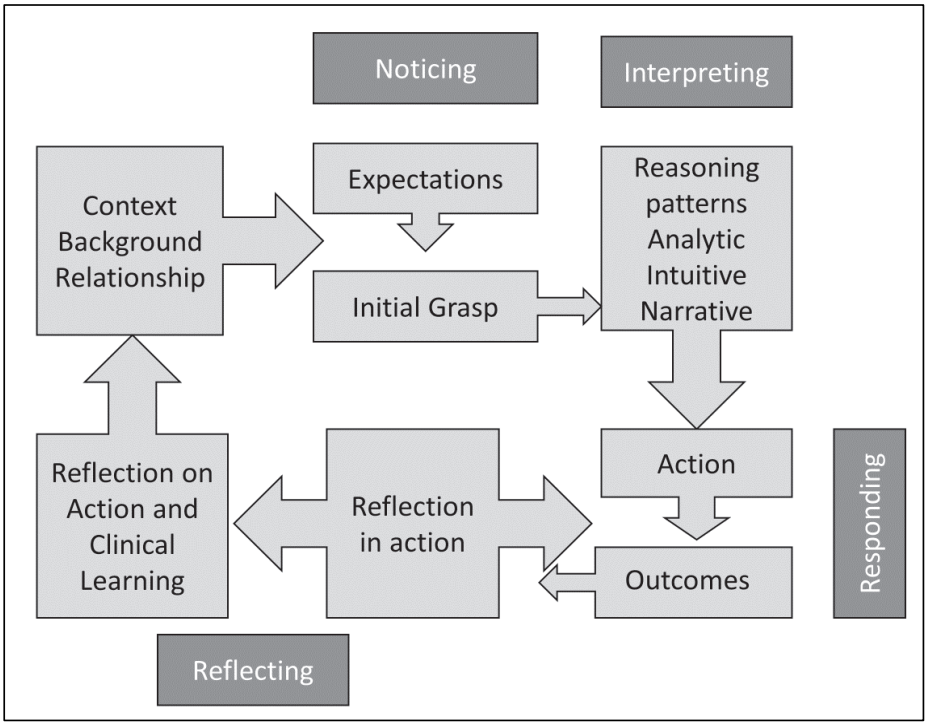


Figure 7.4. Thinking like a nurse, a clinical judgment model adapted from Tanner (54)

Although not mentioned as such by Tanner and Lasater, the four phases of Self-regulated learning can be identified in this model: forethought, monitoring, control, reaction combined with reflection (55). While the rubric is named clinical judgment, the items and descriptions of the rubric (table 4.1) were judged by us as attributes of clinical reasoning, as described in table 7.2.

The further development of Lasater's rubric started qualitatively with a Delphi panel and was accompanied with quantitative procedures to evaluate reliability and validity in hospital setting. This study yielded a translated rubric, with validated measurement and

usable in our practice placements. It can be used to evaluate students' progress in reasoning skills. The measurements with LCJR have been validated also after our study, in other countries and educational environments (56-58). Reliability and validity are not 'fixed properties' of an instrument, but are specific to the measurement with the instrument in a particular context (59). However, this repeated testing builds the case for deploying this rubric in similar contexts.

Because the rubric is grafted on a nursing model, the rubric is difficult to compare with other health professions' measurement tools. The tool has not yet been tested in determining growth across years and among higher levels of the skills acquisition model.

Contribution to educational design model

The rubric can be applied to evaluate the outcome of clinical reasoning education in practice.

Teaching clinical reasoning in practice

How can we support teaching and learning in clinical practice?

Although learning is considered as student activity, teaching and learning are highly correlated (60). According to Self-regulated learning theory, students plan, set aims, perform and monitor their care provision and learning activities, and evaluate and reflect on the process and outcomes. Students' learning in our setting was supported by mentors and nurse educators. When it comes to supporting the development of clinical reasoning, the mentors missed practical guidelines (61). Moreover, the students in our clinical practice had to deal with some known barriers, like cognitive load, lack of knowledge, and not yet well-developed thinking processes (48, 62). Based on the illness script study, we sought a teaching strategy that would facilitate students in organizing experiential knowledge. Debriefing, as used in simulation education, is intended to promote reflection and building illness scripts (63, 64). Hence, we set up a design-based research (DBR) process to develop and implement a practical debriefing procedure, suitable to our educational environment. In debriefing, we provoke interaction with others (65), questioning (66), self-explanation (67) and reflection (68), thus combining different teaching strategies. We assumed that through debriefing, students might learn more about the patients they cared for, and to give meaning to their observations and findings.

DBR is characterized as a cyclical process, accompanied by reflection and evaluation, in which three phases can be identified: exploration and analysis, construction and design, enactment and evaluation (69). We explored and designed through workshops, tested and enacted, in collaboration with nurse educators, a short peer-debriefing procedure which was structured into four questions. Along the designed debriefing procedure, we asked the students to generate a mind map about a patient after debriefing.

We found that debriefing in clinical practice is possible, the impact of debriefing can be monitored with mind maps and focus group discussions. Both indicated that, if students debriefed (and drew a mind map), they exhibited a broader view of the patient in his

situation, which fits nursing clinical reasoning as described above. The collaboration between nurse educators and the researcher seems to be an effective construct, it provoked integration of science, teaching and practice.

We found that mind maps are informative for students and their mentors or educators. The mind maps showed insight into what students learned from patients, and the knowledge organizing script components could be identified in the mind maps. Quality differences in the three measurements during try-out and enactment could be identified.

The prerequisites of design, the outcomes of the workshops and the results of enactment cycles were articulated into design principles. For example, mentors should be included in the debriefing peer-led procedure, to realize daily debriefings. Another principle found was that debriefing has to fit into the daily schedule of a unit.

To take the full benefit of debriefing and its contribution to self-regulated learning (70), more effort turned out to be necessary in our context. We found that the success of enactment of debriefing and mind mapping is largely determined by factors situated in the context. Hence, as a next step, the debriefing procedure is now incorporated in the usual practices of the DEUs of daily pre-briefing, reflections and evaluations.

Contribution to educational design model

To enhance learning activities concerning clinical reasoning in students, structured debriefing can be used as a strategy in clinical practice.

How does context interfere with educational innovation?

During the enactment of the designed debriefing procedure, we noticed signs that variation and routines influence the process as well as the outcome of this teaching intervention. In a perspective paper we explored the question, *"how can implementing new learning tools in hospital practice lead to sustainable change?",* to gain knowledge about supporting teaching. We compared our findings from the research diary, evaluations and focus group discussions on routines and variance, as a case, with theories about practice and routines (71, 72). We learned that characteristics of our setting and elements of routine dynamics are likely to induce variance in enactment of innovations. For example, the sometimes competing interests of students, supervisors and nurse educators might give rise to different understandings and actions. The second finding was that daily routines are important in nursing, routines in general promote continuity. Routines are shaped by context, uncertainty, role taking, individual and joint understandings and actions and by new policies or innovations. New routines may emerge, but this process is difficult to control.

The DBR approach is iterative and three cyclic phases could be identified: exploration and analysis, construction and design, and implementation and evaluation (69). We propose that the aspects of routine dynamics have to be taken account of in every DBR phase, to make a more intelligent use of the environment and to bridge the gap between research and practice effectively.

Contribution to educational design model

The findings of this paper add to the relevance of situativity theory in educational design, for learning and also for teaching. This theory should be added to the model.

Findings in the light of theory; future research questions

In Chapter 1 we introduced three learning theories or frameworks. With this thesis they were given practical significance and we placed them in the educational design model (Figure 7.1.).

Skills acquisition model

This model explains differences in the use of knowledge and knowledge structures between novices and experts and lay the groundwork for the rubric study, illness script study and the debriefing questions.

Illness script theory proposes illness script as a concept, made up of components. It also proposes that novices, experienced professionals and experts differ in the maturity and richness of these components (41). We only studied the first part, the concept. Illness scripts have mainly been investigated in medicine. With our study the applicability of illness script theory concerning the concept can be broadened to nursing. A future research question could be: *Can illness scripts in nursing explain differences in nursing expertise of novices, experience and expert nurses?*

In the thesis, we found a discrepancy between the review findings and illness script theory concerning the importance of knowing the patient. Illness scripts provoke early recognition of problems, also in new patients, who are not yet well-known by the nurse. Many nursing authors stress the significance of knowing the patient, and view this as an antecedent. An explanation might be that these conflicting findings reflect the focus of reasoning, on either 'the sickness' or 'the sick'. What is the actual role of knowing the patient in nursing, or can this knowing also partly be explained by formed illness scripts? A future research question could be*: How is 'knowing the patient' perceived by nurses in acute care settings?*

The rubric designed, uses four levels of development, from beginner to expert. The original LCJR and the Dutch version were designed for students, so the behaviour describing expert level should reflect the level of a newly graduated nurse. However, we found that the relation between experience and scores was weaker for the most experienced students. So, this study also generates a new question. *How can the rubric be adapted to use for professionals, newly registered nurses, the experienced and experts?*

Self-regulated learning theory

This theory plays an important role in the arrangements of clinical learning in our setting. The characteristics of self-regulated learning (SRL) were used as design prerequisites

and principles in the DBR study. Debriefing can structure the monitoring phase of self-regulated learning. The designed procedure could be enriched in a next iteration to enhance self-regulated learning, by teaching the students how to set new goals, for focused observation or communication skills, for example. This will help them learn *after* the debriefed situation (70).

We also recognized alignment between SRL and Tanner's 'Thinking like a nurse model' (54, 55). This might bring nursing content to the SRL phases. In thinking like a nurse, a nurse 'brings something to the situation at hand´: expertise, knowledge, and values. In terms of SRL, this is cognition, meta cognition, motivation and affect. We recognized this subjective influence also in the nursing illness scripts, for example in the explicative statements and impact components. So far, to our knowledge, the influence of what a 'student brings to the situation', like his motivation to learn clinical reasoning in nursing, has not been studied. So, a future research question could be: *Can students' development in clinical reasoning be explained by motivation to learn?*

In this thesis we studied clinical reasoning, but did not investigate reasoning flaws and errors, or misunderstandings of patient problems. Since SRL is about learning to learn, it would be also interesting to study how we can teach students to learn from their mistakes, or how to prevent making them or how to correct them (73). A future research question could be: *How are flaws in reasoning discussed among students, and how can this be used to learn?*

Situativity theory

In all the thesis chapters, environment, context or situation are mentioned. Situativity theory concerns learning, reasoning and teaching, all situated in everyday activities, the habits of workplaces, in collaboration and supported by others. Knowledge and reasoning are situated in experiences, located in communities of practice (74, 75).

In our integrative review, aspects of situativity were found in the contextual factors of reasoning. The care context, workload or time pressure influences clinical reasoning (1, 15). We also found that clinical reasoning is not just an individual process, but often a joint effort of (interprofessional) small teams. From SRL we learn that feedback is essential for learning, as it is for sound clinical reasoning (76). The role and the nature of feedback, in the development of clinical reasoning is a question for further research. *Can (interprofessional) patient discussions improve data interpretation by students?* For future research it is also interesting if our findings (differences and commonalities) can be empirically established, in interprofessional teams in the workplace, like Huesmann et al., recently did (30).

In nursing illness scripts, we also found signs of situative influences. The management, boundary and occurrence components are results of environments. Van Schaik et al. (43) also recognize context in medical illness scripts. Context, through experiences, influences illness script formation. Future research might investigate the formation of nursing illness scripts in other contexts, in psychiatry or community-care nurses. *What are the differences*

and commonalities between illness scripts between different kinds of nurses? Can these be explained by the working contexts?

In the rubric study, the lack of situation sensitivity is mentioned as a limitation of our study and the rubric. The complexity of the environment or of a patient situation have not been taken into account. We did not investigate, for example if students are scored consistently during quiet or busy and demanding shifts. So a future research question could be: *Is there a relation between patient complexity and students' scores on the LCJR?*

In the debriefing study, the DBR approach was chosen because of its relation to local context. We learned that introducing a debriefing procedure will probably be more successful if it fits with already introduced educational practices and the daily schedule of a unit. A future research question might be: *What are the perceptions and values of nurses, management and students on learning through work and from work?*

Not only are reasoning and learning situational in nature, but this situational nature also counts for teaching. Durning et al., (75) outline the differences in teaching caused by the situation. The nurse educators in our study adapt to teaching opportunities of DEUs and the motivation of students.

In the last chapter we elaborated on the situativity of design-based research. We presume that routines and routine dynamics shape nursing educational practice. It would be very interesting, also when introducing new nursing procedures, to investigate this. *Which elements of routine dynamics can be shown empirically in clinical practice and how they can be influenced?*

Strengths and limitations

The strengths and limitations of each study are described in the earlier chapters. This thesis, as an entity of studies, adds to the body of knowledge on clinical reasoning. The rich medical and nursing literature is used in the review and illness script study. Our findings build on this tradition and link professional reasoning to teaching and learning. Both medical and nursing literature are used throughout the thesis. We consider this a strength of our research, the findings may serve interprofessional collaboration in practice, education and research.

Most research on education of clinical reasoning concerns the teaching in schools or at universities, preparing students for practice. In our studies, we focused on clinical teaching and learning, and the patients and the contexts were real-life. The research in this thesis is based on theories. The studies in this thesis, are conceived from a sound knowledge of the current situation and an ambition to improve it.

A limitation might be the choices for hospital settings, and in particular the settings in two large Dutch university hospitals. This choice might influence generalizability of findings. This is not the case for the Lasater Clinical Judgment Rubric. This rubric is translated in many countries and tested in different teaching settings; together the case is built that the assessment with this rubric is reliable and valid.

Although the studies, the review excepted, were conducted locally, the steering research questions were general, concerning the education of clinical reasoning of nursing students. The nursing illness script we describe can be considered as a first step; it needs testing in other contexts with nurses of different (levels of) expertise. But, because of the similarities found in medical studies on illness scripts, we consider our illness script not a local finding.

The debriefing study was organized as a DBR project. DBR is meant for local problems, to find local solutions, but to produce through these generalizable design principles. The designed debriefing is theory-based, and debriefing has been tested in other teaching settings. Our findings showed that more time is needed, for more iterations with a more intelligent use of context.

In nursing, as in medicine, evidence-based practice is highly valued. Did our studies add to the body of evidence for clinical teaching? First of all, most of our studies were explorative in nature. Secondly, most of our studies were qualitative and we worked within an interpretative stance. Educational research is often more interested in how and why something works than what works (77, 78), evidence is used to improve teaching practice. Education and the context are complex, this has implications for study methods. Methods with more evidentiary value are hard to accomplish in education, or might only focus on measurable questions and answers, like student satisfaction. Educational research must be replicated in many teaching situations to build evidence for explanations and understanding (79). This thesis aimed to contribute to this evidence building, we may add the nursing illness script and an expansion of the use of a rubric an debriefing in clinical settings to this educational evidence.

Actionable knowledge

The title of this thesis, *How to train clinical reasoning in nursing students: actionable knowledge,* was chosen for two reasons. Actionable knowledge refers to knowledge for everyday practice (80). The knowledge nurses use in clinical reasoning might be formal, scientific, procedural, experiential, personal or evidence-based, all intended and transformed into nursing activities: to diagnose, to set a plan, to intervene. Knowledge gives direction to 'what should be done' (81). Actionable knowledge is related to clinical questions and decisions.

With this thesis we also aimed to gain actionable knowledge, based on sound research and at the same time applicable in everyday learning and teaching practice. Actionable knowledge is based on engaged research and is relevant to practice. It embraces participation and usability of knowledge (82, 83). Actionable knowledge is knowledge justified through evidence, with clinical or practical relevance. We presume that with this thesis we add to both aspects of knowledge: the use of reliable investigations methods as a means to justify the findings and its relevance for teaching practice.

The use of an educational design model aligns with the pursuit for actionable knowledge. We contributed with our findings to formulating objectives, to teaching content,

to outcome evaluation, to students' learning activities and teaching strategies. However, this practical model, according to our findings, needs the guiding underpinnings of learning theories; they also give directions to 'what should be done'.

The pictures on the front and back of this thesis are intended to indicate who this thesis benefits and to what this thesis contributes.

The picture is titled La *La science et la charité (Science and benevolence),* painted by Ravage. The photo on the back is of the student pin of the VU nursing school (until 1997). The training motto of this school was *caritati scientia servitat (Knowledge serves mercy).* Science and knowledge building are *at the service of patient care, the conduct of research is justified by this purpose.*

Implications and recommendations

To enhance clinical reasoning in nursing students, explicit attention is needed to how clinical reasoning is understood and how expertise develops. Students need clear, directional feedback on their developing reasoning skills, and this development should structurally be supported in clinical practice. Several practical implications based on our findings were mentioned earlier as contributions to the educational model. In addition, based on our findings, we may recommend that:

1. We found that clinical reasoning is also a collaborative process. Individual clinical reasoning processes must be articulated and shared, between colleagues, between members of interprofessional teams and between supervisors and students, between students. A common language is required to do so. This language could be based on our onion model.
2. The ground works for clinical reasoning is provided in schools or universities. Even in 2023, (84) clinical reasoning is not yet implemented in all health profession curricula. Because clinical reasoning is related to patient safety and becoming a valued member of an interprofessional team, students have to be prepared before entering the practice.
3. The teaching of clinical reasoning in practice happens ad hoc and is dependent on the expertise of supervisors. A clinical teaching programme could be developed, including supervisor training, instructions how practice can be used for teaching and learning (the doctors' daily visits), pre-briefing and debriefing, and feedback and evaluation.
4. Schools and practice have to collaborate in the clinical reasoning development programs (85). The language and assignments have to be aligned between theory and practice. Nursing Illness script, it's components, can give directions to this collaboration.
5. Lifelong learning also applies to clinical reasoning. Even experts need feedback or can learn from mistakes. This means that an open learning climate in which every participant is learner and simultaneously coach, should be encouraged.

6. To make optimal use of the clinical learning possibilities, acceptance of teaching as an important goal of hospital units is required. Give 'power' to students, supervisors and educators when it comes to facilitating teaching and learning.
7. Situativity has to be organized to cash-in on the effects for learning and teaching. Participation, interaction, feedback, use of contextual opportunities and breaking down barriers needs to be ensured.

Conclusion

This thesis was built on the question "*How is clinical reasoning conceptualized and shaped in nursing and how can this be applied to clinical teaching and evaluation?"* This question has guided our research and resulted in an adapted model for the design of clinical reasoning education in practice. We deconstructed the concept clinical reasoning into many aspects. These aspects might inform education development. We could identify a nursing illness script, and its components may give directions to education development as well. The rubric can be used in formative evaluations of students' clinical reasoning in practice, and debriefing seems a promising teaching strategy. We view our results as an invitation for more research and continuous improvement in the design of clinical reasoning programmes. Patients and students deserve this actionable knowledge. The caring and learning situations are key ingredients in (learning to) think like a nurse.

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Summary

The broad research question of this thesis was: “How is clinical reasoning conceptualized and shaped in nursing and how can this be applied to clinical teaching and evaluation?”

Clinical reasoning is the term used to describe the thought processes leading from a patient and his problem to sound caring practices. Clinical reasoning is an important skill for healthcare professionals. Catching early signs of deterioration, reaching an appropriate diagnosis and applying a suitable intervention is vital for patients. In this process, the clinical reasoning of healthcare professionals is pivotal.

While knowledge of anatomy and pathology is important, experiential knowledge also plays a major role in the development of clinical reasoning. It is not clear to mentors and nurse educators how they can guide students in acquiring this form of experiential knowledge.

Despite it being studied for years, there are gaps in the knowledge of clinical reasoning in the literature, such as: What exactly is clinical reasoning? How is experiential knowledge constructed? Can you measure clinical reasoning? Which teaching strategy might work?

These questions guided our research on clinical reasoning, with the aim to improve the clinical reasoning education of nursing students in practice, for the benefit of patients.

This thesis focuses on nurses and nursing students, specifically in hospitals.

Chapter 1

In Chapter 1, we have summarised what is currently known about clinical reasoning. Throughout this thesis, we have used the following definition: Clinical reasoning is a complex process that uses cognition, metacognition and discipline-specific knowledge to gather information about the patient, analyse it, evaluate its meaning and weigh alternative actions.

For nurses, knowing the patient as a person is important. For sound judgement, nurses also use their subjective understanding about a patient's situation. We have used several learning theories or models in our research, namely the acquisition of skills model, self-regulated learning theory and situativity theory. These theories also play a role in current (practice) education. The choice of appropriate teaching strategies for clinical reasoning is complicated by the lack of clarity about what comprises clinical reasoning and whether development of clinical reasoning can be assessed. These complications were echoed in many studies on teaching strategies. The strategies studied focussed mainly on learning to articulate observations and experiences.

This chapter concludes with a schematic overview of the thesis in 4 themes: understanding, shaping, evaluating and teaching clinical reasoning in practice.

Chapter 2

Chapter 2 consists of 2 parts. 2A describes the peer-reviewed research protocol for the review and 2B the literature review conducted. To gain more insight into the properties and characteristics of clinical reasoning, we searched the nursing and medical education literature for descriptions of clinical reasoning, of professionals. Data extraction and analysis was guided by layered analysis and concept analysis. We developed an onion model composed of the following shells from inside out: professional paradigm, underpinning theories, intentions of clinical reasoning, antecedents, attributes and content of clinical reasoning, the reasoning outcomes and contextual factors. There were many similarities between doctors and nurses, but also differences. These differences went beyond the familiar cure-care continuum. Nurses, in comparison with doctors, valued subjective information more, focussed not only on the patient's condition but on the broader situation, focussed on the patient and their relatives, and wanted to understand rather than explain the patient situation. They also looked for links which were more often related rather than causal. A nursing diagnosis described a patient situation, the reactions to a health problem or treatments of the patient and his family. These diagnoses, e.g. pain, were more variable in nature than medical diagnoses and often the patient himself was involved in reaching a nursing diagnosis.

This systematic description of the facets of clinical reasoning could help in (interprofessional) education, in collaborating in the care team and in comparing results from research. In provision of good patient care, medical reasoning and nursing reasoning complement each other.

Chapter 3

This chapter describes research on nurses' illness scripts. Research on medical specialists and medical students showed that specialists store theoretical and specifically experiential knowledge in their memory in a certain structure, which ensures that this information can be retrieved quickly. This would explain why specialists diagnose faster and better than students, but also rely on non-medical background information, such as age or job. This knowledge structure in long-term memory is called illness script and this script consists of several components.

We asked specialist nurses with more than 10 years' experience in their wards, to think aloud about 20 patient problems, from agitation to wound healing. We analysed their accounts, and from this we were able to also identify a nursing illness script. Like doctors, nurses have a rich memory of signs and symptoms, and common interventions. Nurses can also produce information about causes or possible relationships (e.g. pain after surgery). The illness scripts of specialists are characterised by the high proportion of background information, among nurses this was less prominent. In contrast, nurses also shared information about impact of the problem, both in the patient and in themselves, about prevalence (loneliness is less diagnosed in an ICU), and about the situations where other expertise is needed, e.g. that of a doctor or pastor.

The results of this research could help in designing education. It creates the awareness of the need to pass on to our students broader knowledge than that restricted to the disease and symptoms. The components of nursing illness script also comprise circumstantial information, information about prevalence of problems, information on the boundary of nursing, and on the impact of problems for patients and caretakers. Epidemiological information such as, gender or socioeconomic status, helps physicians to diagnose. This might also be the case for nurses.

Chapter 4

This chapter describes the design and validation of an assessment tool to capture the development of clinical reasoning in nursing students. We used an existing instrument: the Lasater Clinical Judgment Rubric. A rubric describes behavioural aspects, and in this case across 4 developmental stages from novice to expert. The items and the behaviours described are based on the 'Thinking like a nurse' model. The rubric was designed for simulation teaching. We translated the rubric, adapted it to the Dutch clinical situation and tested it at dedicated educational units. It is difficult to evaluate observations, a common language is needed for feedback and to describe the expected behaviour. The rubric can support this. From several aspects of validity and reliability we tested, we concluded that this Dutch version of Lasater's rubric gives a reliable measurement of students' progress on clinical reasoning.

Chapter 5

In order to design a clinical teaching strategy that promotes students' clinical reasoning and fits into our practice, we conducted a study using the design-based research (DBR) approach in collaboration with nurse educators. DBR is characterized by three phases: exploration and analysis, construction and design, and implementation and evaluation, accompanied by reflections and evaluations.

This kind of research leads to 2 outcomes: a design and design principles (theoretical and practical starting points) for a subsequent design or to enlarge knowledge on underlying theories. We designed a peer-debriefing procedure, structured with 4 questions based on the research on illness scripts. Debriefing was trialled and subsequently enacted on several units. We surveyed the consequence of debriefing among students, by asking them to submit a mind map of a patient. Focus group discussions were also conducted with students and nurse educators. Implementation was variably successful on the different units. But debriefing did encourage clinical reasoning, students reported noticing more facets of the patient as shown in the mind-maps they created. Nurse educators noticed that exploring and designing energised them, and implementing cost them energy. Examples of design principles found are, that debriefing should be aligned with students' motivation to learn (i.e. not right before a test) and that debriefing should fit into the ward's daily schedule.

Chapter 6

Our last article was written on the basis of our experiences of design-based research (DBR). In this type of research, a journal is kept by the researcher and evaluations and reflections are collected at each step. Halfway through this process, we observed that routines in the ward and variations in enactment of the intervention influence the success of implementation. DBR assumes that the gap between theory and practice can be bridged by this type of research. We compared our experiences with sociological theories on practice, routines and their dynamics. A routine has the function of creating order, of providing structure in complex environments, such as in a hospital ward.

A routine is shaped by several elements, such as policy, uncertainty, individual and shared beliefs and the context. Routines, patterns of activities, tend to preserve what exists, while setting a new routine is hard to control. All the elements of routines could be recognised in our setting. Due to individual and shared views of subgroups, variations and alternatives in the designed procedures may arise. Thus, we put forth that for sustainable change in practice, the context and especially the dynamics of routines must be involved in the phases of exploration and analysis, design and implementation. The variation explained by routine dynamics, complicates the evaluation of an implementation.

Chapter 7

This chapter describes the main findings of the thesis and answers the broad research question. The findings are ordered by themes and the three theories used. Conceptualisation and formation of clinical reasoning, evaluation and training, are considered in light of self-regulated learning, situativity and stages of development. The findings in turn lead to questions for future research.

Our findings can be fitted into a general educational design model. The results of the review on clinical reasoning can be used to formulate the objectives of a clinical reasoning programme. The nursing illness script and its components can be used to determine the content of a clinical reasoning programme, e.g. knowledge of symptoms and signs and also of epidemiological factors The rubric can evaluate the development of reasoning in nursing students in a reliable manner. Debriefing appears to promote students' clinical reasoning. Within the study period, this form of debriefing was not yet well-implemented. This could partly be explained by the influence of routines and their dynamics on implementation of an intervention. We also found some design principles, including that new teaching interventions should fit in with existing ones and fit within the daily schedule of the department. We plan to integrate these design principles into the next round of implementation.

In addition, we created an onion model that can be used to examine clinical reasoning. This allowed us to explore the differences between medical and nursing reasoning. With the illness script study, we were able to expand the medical knowledge on illness scripts. In the debriefing study, we also designed a method to analyse mind maps, and saw that mind-maps provide insight into what patient information students notice in practice.

Actionable knowledge means reliable investigations that have practical relevance. In this thesis, we pursued both aspects. Hence the title, “How to train clinical reasoning in nursing students: actionable knowledge”.

Samenvatting

De brede onderzoeksvraag van deze thesis was: "Hoe wordt klinisch redeneren in de verpleegkunde geconceptualiseerd en gevormd en hoe kan dit worden toegepast op klinisch onderwijs en evaluatie?".

Klinisch redeneren is de term die gebruikt wordt om de denkprocessen te beschrijven die leiden van een patiënt en zijn probleem naar een goede zorgverlening. Klinisch redeneren is een belangrijke vaardigheid voor professionals in de gezondheidszorg. Het vroegtijdig opmerken van verslechtering, het stellen van de juiste diagnose en het toepassen van een geschikte interventie is van vitaal belang voor patiënten. In dit proces is het klinisch redeneren van professionals in de gezondheidszorg van cruciaal belang.

Kennis van anatomie en pathologie is belangrijk, maar ervaringskennis speelt ook een grote rol in de ontwikkeling van klinisch redeneren. Het is voor werkbegeleiders en praktijkopleiders niet duidelijk hoe ze studenten kunnen begeleiden in het verwerven van deze vorm van ervaringskennis.

Ondanks dat klinisch redeneren al jaren onderzocht wordt, zijn er in de literatuur hiaten in de kennis over klinisch redeneren, zoals: Wat is klinisch redeneren precies? Hoe wordt ervaringskennis gevormd? Kun je klinisch redeneren meten? Welke onderwijsstrategie zou kunnen werken?

Deze vragen vormden de leidraad voor ons onderzoek naar klinisch redeneren, met als doel het verbeteren van het onderwijs in klinisch redeneren van verpleegkundestudenten in de praktijk, ten behoeve van patiënten.

Dit proefschrift richt zich op verpleegkundigen en studenten verpleegkunde in ziekenhuizen.

Hoofdstuk 1

In hoofdstuk 1 hebben we samengevat wat er op dit moment bekend is over klinisch redeneren. In dit proefschrift hebben we de volgende definitie gebruikt: Klinisch redeneren is een complex proces dat cognitie, metacognitie en discipline-specifieke kennis gebruikt om informatie over de patiënt te verzamelen, te analyseren, de betekenis ervan te evalueren en alternatieve interventies af te wegen.

Voor verpleegkundigen is het belangrijk om de patiënt als persoon te kennen. Voor een goed oordeel gebruiken verpleegkundigen ook hun subjectieve begrip van de situatie van een patiënt. We hebben verschillende leertheorieën of -modellen gebruikt in ons onderzoek, namelijk het model Vaardigheidsverwerving in ontwikkelstadia, de theorie van Zelfregulerend leren en de Situativiteitstheorie. Deze theorieën spelen ook een rol in het huidige klinische onderwijs. De keuze van geschikte onderwijsstrategieën voor klinisch redeneren wordt bemoeilijkt door het gebrek aan duidelijkheid over wat klinisch redeneren inhoudt en of de ontwikkeling van klinisch redeneren kan worden beoordeeld. Deze complicaties werden genoemd in veel studies naar onderwijsstrategieën. De bestudeerde strategieën waren vooral gericht op het leren verwoorden van observaties en ervaringen.

Dit hoofdstuk sluit af met een schematisch overzicht van het proefschrift in 4 thema's: begrijpen, vormen, evalueren en onderwijzen van klinisch redeneren in de praktijk.

Hoofdstuk 2

Hoofdstuk 2 bestaat uit 2 delen. 2A beschrijft het peer-reviewed onderzoeksprotocol en 2B de uitgevoerde literatuurstudie. Om meer inzicht te krijgen in de eigenschappen en kenmerken van klinisch redeneren, zochten we in de verpleegkundige en medische literatuur naar beschrijvingen van klinisch redeneren, van professionals. Gegevensextractie en -analyse werden geleid door Gelaagde analyse en Conceptanalyse. We ontwikkelden een ui-model bestaande uit de volgende schillen van binnen naar buiten: professioneel paradigma, onderbouwende theorieën, intenties van klinisch redeneren, antecedenten, attributen en inhoud van klinisch redeneren, de redeneeruitkomsten en contextuele factoren. Er waren veel overeenkomsten tussen artsen en verpleegkundigen, maar ook verschillen. Deze verschillen gingen verder dan het bekende cure-care continuüm. Verpleegkundigen hechtten in vergelijking met artsen meer waarde aan subjectieve informatie, richtten zich niet alleen op de toestand van de patiënt maar op de bredere situatie, richtten zich op de patiënt en zijn naasten, wilden de patiëntsituatie eerder begrijpen dan verklaren. Ze zochten ook meer naar samenhang dan oorzakelijke verbanden. Een verpleegkundige diagnose beschrijft een patiëntsituatie, de reacties op een gezondheidsprobleem of behandelingen, van de patiënt en zijn naasten. Deze diagnoses, bijvoorbeeld pijn, zijn variabeler van aard dan medische diagnoses en vaak is de patiënt zelf betrokken bij het stellen van een verpleegkundige diagnose.

Deze systematische beschrijving van de facetten van klinisch redeneren zou kunnen helpen bij (interprofessioneel) onderwijs, bij samenwerking in het zorgteam en bij het vergelijken van resultaten uit onderzoek. Bij het verlenen van goede patiëntenzorg vullen medisch redeneren en verpleegkundig redeneren elkaar aan.

Hoofdstuk 3

Dit hoofdstuk beschrijft onderzoek naar ziektescripts van verpleegkundigen. Onderzoek onder medisch specialisten en medisch studenten toonde aan, dat specialisten theoretische en vooral ervaringskennis in een bepaalde structuur in hun geheugen opslaan, wat ervoor zorgt dat deze informatie snel kan worden opgehaald. Dit zou verklaren waarom specialisten sneller en beter diagnoses stellen dan studenten, maar ook vertrouwen op niet-medische achtergrondinformatie, zoals leeftijd of baan van de patiënt. Deze kennisstructuur in het langetermijngeheugen wordt ziektescript genoemd en dit script bestaat uit verschillende componenten.

We vroegen gespecialiseerde verpleegkundigen met meer dan 10 jaar ervaring op hun afdelingen hardop na te denken over 20 patiënten problemen, van agitatie tot wondgenezing. We analyseerden hun verhalen en daaruit konden we ook een verpleegkundig ziektescript identificeren. Net als artsen hebben verpleegkundigen een rijk geheugen voor verschijnselen en symptomen en veelvoorkomende interventies.

Verpleegkundigen kunnen ook informatie terughalen over oorzaken of mogelijke samenhangen (bijv. pijn na een operatie). De ziektescripts van specialisten worden gekenmerkt door het grote aandeel achtergrondinformatie, bij verpleegkundigen was dit minder prominent aanwezig. Verpleegkundigen deelden daarentegen ook informatie over de impact van het probleem, zowel bij de patiënt als bij henzelf, over prevalentie (hoe gebruikelijk een probleem op de afdeling was) en over de situaties waarin andere expertise nodig is, bijvoorbeeld die van een arts of pastor.

De resultaten van dit onderzoek kunnen helpen bij het ontwerpen van onderwijs. Het creëert het bewustzijn van de noodzaak om onze studenten bredere kennis bij te brengen dan alleen over ziekte en symptomen. De componenten van het verpleegkundig ziektescript bestaan ook uit omgevingsinformatie, informatie over prevalentie van problemen, informatie over de grens van verpleging en over de impact van problemen voor patiënten en zorgverleners. Epidemiologische informatie, zoals geslacht of sociaaleconomische status, helpt artsen bij het stellen van een diagnose. Dit zou ook het geval kunnen zijn voor verpleegkundigen.

Hoofdstuk 4

Dit hoofdstuk beschrijft het ontwerp en de validatie van een beoordelingsinstrument om de ontwikkeling van klinisch redeneren bij studenten verpleegkunde vast te leggen. We gebruikten een bestaand instrument: de Lasater Clinical Judgment Rubric. Een rubric beschrijft gedragsaspecten, en in dit geval over 4 ontwikkelingsstadia van beginner tot expert. De items en het beschreven gedrag zijn gebaseerd op het 'Thinking like a nurse'-model. De rubric is ontworpen voor simulatieonderwijs. We hebben de rubric vertaald, aangepast aan de Nederlandse klinische situatie en getest op leerwerkplaatsen. Het is moeilijk om observaties te evalueren, er is een gemeenschappelijke taal nodig voor feedback en om het verwachte gedrag te beschrijven. De rubric kan dit ondersteunen. Uit de verschillende aspecten van validiteit en betrouwbaarheid die we hebben getest, hebben we geconcludeerd dat deze Nederlandse versie van Lasater's rubric een betrouwbare meting geeft van de vooruitgang van studenten op het gebied van klinisch redeneren.

Hoofdstuk 5

Om een klinische onderwijsstrategie te ontwerpen die het klinisch redeneren van studenten bevordert en past in de klinische leeromgeving, hebben we een onderzoek uitgevoerd met behulp van de design-based research (DBR) benadering in samenwerking met praktijkopleiders. DBR wordt gekenmerkt door drie fasen: exploratie en analyse, constructie en ontwerp, en implementatie en evaluatie, vergezeld van reflecties en evaluaties.

Dit soort onderzoek leidt tot 2 uitkomsten: een ontwerp en ontwerpprincipes (theoretische en praktische uitgangspunten) voor een volgend ontwerp of om kennis over onderliggende theorieën te vergroten. We ontwierpen een peer-debriefingprocedure, gestructureerd met 4 vragen, gebaseerd op het onderzoek naar ziektescripts. Debriefing

werd uitgeprobeerd en vervolgens ingevoerd op verschillende afdelingen. We onderzochten het gevolg van debriefing onder studenten door hen te vragen een mindmap van een patiënt te tekenen. Er werden ook focusgroep discussies gehouden met studenten en praktijkopleiders. De implementatie was wisselend succesvol op de verschillende afdelingen. Desondanks stimuleerde de debriefing het klinisch redeneren, studenten van alle afdelingen gaven aan meer facetten van de patiënt te zien, ook zichtbaar in de mindmaps die ze hadden gemaakt. Praktijkopleiders merkten dat het verkennen en ontwerpen hen energie gaf en het implementeren hen energie kostte. Voorbeelden van gevonden ontwerpprincipes zijn dat debriefing moet worden afgestemd op de motivatie van studenten om te leren (dus niet vlak voor een toets) en dat debriefing moet passen in het dagelijkse schema van de afdeling.

Hoofdstuk 6

Ons laatste artikel is geschreven op basis van onze ervaringen met design-based research (DBR). Bij dit type onderzoek houdt de onderzoeker een dagboek bij en worden bij elke stap evaluaties en reflecties verzameld. Halverwege dit proces merkten we dat routines op de afdeling en variaties in de uitvoering van de interventie van invloed zijn op het succes van de implementatie. DBR gaat ervan uit dat de kloof tussen theorie en praktijk door dit type onderzoek kan worden overbrugd. We vergeleken onze ervaringen met sociologische theorieën over de praktijk, routines en hun dynamiek. Een routine heeft de functie om orde te scheppen, om structuur te bieden in complexe omgevingen, zoals op een ziekenhuisafdeling.

Een routine wordt gevormd door verschillende elementen, zoals beleid, onzekerheid, individuele en gedeelde overtuigingen en de context. Routines, patronen van activiteiten, hebben de neiging om het bestaande te behouden, terwijl het moeilijk is om een nieuwe routine in te stellen. Alle elementen van routines waren te herkennen in onze setting. Door individuele en gedeelde opvattingen van subgroepen kunnen er variaties en alternatieven ontstaan in de ontworpen procedures. Daarom stellen we dat voor duurzame verandering in de praktijk, de context en vooral de dynamiek van routines betrokken moeten worden bij de fasen van exploratie en analyse, ontwerp en implementatie. De variatie die verklaard wordt door routinedynamiek bemoeilijkt de evaluatie van een implementatie.

Hoofdstuk 7

Dit hoofdstuk beschrijft de belangrijkste bevindingen van het proefschrift en geeft antwoord op de brede onderzoeksvraag. De bevindingen zijn geordend naar thema's en de drie gebruikte theorieën. Conceptualisatie en vorming van klinisch redeneren, evaluatie en training worden beschouwd in het licht van zelfregulerend leren, situativiteit en ontwikkelingsstadia. De bevindingen leiden op hun beurt tot vragen voor toekomstig onderzoek.

Onze bevindingen kunnen worden ingepast in een algemeen model voor onderwijsontwerp. De resultaten van de review over klinisch redeneren kunnen worden gebruikt om de doelstellingen van een programma voor klinisch redeneren te formuleren.

Het verpleegkundig ziektescript en zijn componenten kunnen gebruikt worden om de inhoud van een programma klinisch redeneren te bepalen, bv. kennis van symptomen en verschijnselen en ook van epidemiologische factoren. De rubric kan de ontwikkeling van redeneren bij studenten verpleegkunde op een valide en betrouwbare manier evalueren. Debriefing kan het klinisch redeneren van studenten te bevorderen. Binnen de onderzoeksperiode was deze vorm van debriefing nog niet goed geïmplementeerd. Dit zou deels verklaard kunnen worden door de invloed van routines en hun dynamiek op de implementatie van een interventie. We vonden ook enkele ontwerpprincipes, waaronder dat nieuwe onderwijsinterventies moeten aansluiten bij bestaande interventies en moeten passen in het dagschema van de afdeling. We zijn van plan om deze ontwerpprincipes te integreren in een volgende implementatieronde.

Daarnaast creëerden we een ui-model dat gebruikt kan worden om klinisch redeneren te onderzoeken. Hierdoor konden we de verschillen tussen medisch en verpleegkundig redeneren onderzoeken. Met de ziektescriptstudie konden we de (medische) kennis over ziektescripts uitbreiden. In de debriefingstudie ontwierpen we ook een methode om mindmaps te analyseren, en zagen we dat mindmaps inzicht geven in welke patiëntinformatie studenten opmerken in de praktijk.

Bruikbare (actionable) kennis betekent: kennis verkregen door betrouwbaar onderzoek met relevantie voor de praktijk. In dit proefschrift streefden we beide aspecten na. Vandaar de titel "How to train clinical reasoning in nursing students, actionable knowledge".

Dankwoord

"Let us never consider ourselves finished nurses. We must be learning all of our lives"
(quote attributed to Florence Nightingale in the 1800s)

Dit proefschrift is het resultaat van een leerproces, waarbij ik erkentelijk ben aan veel leermeesters, rolmodellen en aardige, behulpzame mensen.

Hooggeleerde vrouwe, lieve Rashmi. Je ontving mij met open armen in het team Onderzoek van Onderwijs. Als een mentor leerde je mij feedback te gaan waarderen, om steeds een uitdaging aan te gaan, en (luie) bescheidenheid af te leggen. Hoe jij werkt, je reis van India tot de oratie, is zo inspirerend om mee te mogen maken! Vaak gebruik je het woord 'exciting', wat ik vertaal in enthousiaste nieuwsgierigheid en mogelijkheden zien voor mooi onderzoek, overtuigende presentaties en impact. Je gaf mij het vertrouwen en dat sterkte mijn zelfvertrouwen. A lesson for life.

De begeleidingscommissie bestond verder uit Eugène, Marcel en Jos. Eugène, dank dat ik mocht voortbouwen op jouw werk over illness scripts. Je kritische vragen brachten me verder. Marcel bekommerde zich niet alleen over het PhD project, maar ook over het wel en wee van de promovendus. Dat hij plotseling overleden is, voelt nog steeds als een verlies. Jos, jouw deskundige, steunende begeleiding èn de inbreng van het verpleegkundig perspectief, daar kan ik niet genoeg waardering over uitspreken. Ik hoop dat mijn begeleiders net zo trots op het proces en resultaat kunnen zijn, als ik.

Een andere persoon die ik graag wil bedanken is Wim. Zonder hem, en ook Sandra, zou ik nooit gedacht hebben aan een promotieproject. Beste Wim, dank dat je mogelijkheden en ambities in mij onderkende, en dat ik tijd kreeg om aan mijn promotieproject te werken. Ook andere managers van de Amstel Academie wil ik graag bedanken. Dyanne en Peter, dank voor jullie ondersteuning, interesse en enthousiasme. Ook Rogier wil ik graag bedanken, hij heeft mij als nieuwe vreemde eend opgenomen in zijn team; dank TAOI-collega's, een spelletje padel doet wonderen!

Het is een beetje vreemd om een heel ziekenhuis te bedanken, maar vanaf 1985 tot nu ben ik steeds mensen tegengekomen, die mij verder brachten, zagen wat ik niet zag, en kansen gaven. Wina, als hoofdverpleegkundige van de neurologie durfde je het aan, met mij als jonge leidinggevende. En Maaike, dank voor de fijne samenwerking en de kansen die je mij gaf om verder te leren (HGZO) en projecten te leiden. De verpleegkundig directeuren, en met name Joost en Jeanette, wil ik graag bedanken voor het meedenken in het gebruik van Amsterdam UMC als onderzoeksetting. Dank ook aan de verpleegkundig hoofden en teamleiders van onze leerwerkplaatsen, jullie gaven mij de gelegenheid om onderzoek op de afdelingen uit te voeren. Deze onderzoeken konden alleen plaatsvinden doordat (gespecialiseerd) verpleegkundigen, werkbegeleiders en studenten geïnteresseerd waren en

wilden deelnemen aan onderzoek. Iedereen heeft het druk, en het onderzoek leverde hun geen persoonlijke voordelen op. Heel erg bedankt, allemaal. Irene en het netwerk verpleegkundig onderzoekers wil ik graag bedanken voor de continue inspiratie en energie. Verpleegkundig onderzoekt groeit, en het is mooi om daar een bijdrage aan te mogen leveren, 'in goed gezelschap'.

De mensen die ik het meest dankbaar ben zijn mijn collega's, de praktijkopleiders. Lieve collega's, de groep is te groot geworden om jullie bij naam te noemen, het was zo fijn dat jullie geïnteresseerd in het onderzoek waren, dat jullie meededen als participanten, of als rubric beoordelaars. Onderzoek doen voelt soms een beetje eenzaam, bij jullie voelde ik me altijd weer onderdeel van een mooie groep! Ook de collega stafadviseurs Onderzoek en Opleiden, dank voor jullie bemiddeling bij het uitvoeren van onderzoek.

Voor het dagelijkse werk als onderzoeker, kwam ik thuis in een nieuw team. Anne, Cora, Emma, Jan Willem, Joyce, Lianne, Marnix, Joram, Lucille, Saskia, Siema, Andries, Ariadne, Stephanie, Ulvije, Maite, Marianne en Bart: jullie willen niet weten hoe jullie mij geholpen hebben. Een praatje over het weekend, over de stress die bij submitten komt kijken, de kritische feedback in Research in progress, het meedenken in het vertalen van data naar rapportage, de presentatie als groep (kaasmeisjes) op een congres; het droeg allemaal bij aan de kwaliteit van mijn werk en het plezier in het werk! Sunia, Louti, Carolyn ben ik extra erkentelijk voor de samenwerking. Jullie hebben een waardevolle bijdrage geleverd aan de onderzoeken, in het analyseren van data. Dank daarvoor. Ook Malou en Anouk wil ik graag extra in het zonnetje zetten. Malou en Anouk, jullie vinden het fijn om te helpen en daar heb ik dankbaar gebruik van gemaakt. Malou, je deed elke stap in het promotietraject voor mij, zodat het voor mij minder eng werd. Je kritische blik, gepaard met relativering en humor, werkte voor mij heel stimulerend. En dan was elke vrijdag óók nog heel gezellig! Anouk, dank dat je mijn stress begreep. Met jouw eerlijke, praktische adviezen kon ik weer verder. Met zijn drieën elke vrijdag op het KTC... die verbondenheid deed mij denken aan de 3 musketiers.

Buiten het team Onderzoek van Onderwijs, heb ik in de coronatijd samengewerkt met Donna. Beste Donna, dank voor het mee-analyseren van de gespreksdata. Een zoom-afspraak met jou, was ook weer een beetje verbinding met de gewone, pre-corona wereld. En ook Bea wil ik graag bedanken. Bea, je leerde mij, behalve statistiek en kwalitatief onderzoek, óók compacter te schrijven.

De beoordelingscommissie van dit proefschrift wil ik graag bedanken voor jullie interesse, tijd en energie.

En dan het thuisfront. We zijn opgevoed met de parabel van de talenten. Een talent stop je niet in de grond, je gaat er mee aan de slag. Mijn vader sprak me aan als ik te veel in het comfort bleef hangen, 'moet je niet weer eens wat meer risico zoeken'? Van mijn moeder heb ik niet alleen de liefde voor verplegen geërfd. Lieve Piem, je geeft me het vertrouwen dat ik het kan, 'wij' hebben veerkracht. Er was nog een opvoed-principe, het leven mag ook bourgondisch gevierd worden. Dank dat jullie ons geleerd hebben dat uitdagingen gepaard moeten gaan met ontspanning, lekker eten en gezelligheid.

Ik ben ooit weer gaan studeren toen Chris de gemeenteraad in ging, en Tom en Loes op zondagen huiswerk gingen maken. Lieve Tom en Loes, jullie moeten zelf (nog) niet aan promoveren denken, maar ik voelde me toch gesteund, omdat jullie het leuk vinden dat ik dit wèl doe (op mijn oude dag). Het brengt ons ook weer dichter bij elkaar, omdat onze studie-ervaringen op elkaar lijken. Lieve Chris, bij jou, thuis, ben ik een mooiere versie van mijzelf geworden. Ik weet dat je trots op mij bent (en ik op jou), maar we kijken ook uit naar zondagen 'zonder artikelen'. Ik hou van je, en kijk uit naar vele jaren met je, en ons werk wat meer op de achtergrond. De quote van Florence Nightingale past mij goed, maar samen met jou leren lijkt me nog leuker.

PhD portfolio

Publications

Vreugdenhil, J., & Spek, B. (2018). Development and validation of Dutch version of Lasater Clinical Judgment Rubric in hospital practice: An instrument design study. *Nurse Educ Today, 62*, 43-51. doi:10.1016/j.nedt.2017.12.013

Vreugdenhil, J., Dopp, D., Custers, E., Reinders, M. E., Dobber, J., & Kusurkar, R. A. (2021). Illness scripts in nursing: Directed content analysis. *J Adv Nurs*. doi:10.1111/jan.15011

Vreugdenhil, J., Somra, S., Ket, H., Custers, E., Reinders, M. E., Dobber, J., & Kusurkar, R. A. (2021). Reasoning like a doctor or like a nurse? An integrative review protocol. *BMJ open, 11*(9), e049862. doi:10.1136/bmjopen-2021-049862

Vreugdenhil, J., Somra, S., Ket, H., Custers, E., Reinders, M. E., Dobber, J., & Kusurkar, R. A. (2023). Reasoning like a doctor or like a nurse? A systematic integrative review. *Front Med 10*, 1017783. doi:10.3389/fmed.2023.1017783

Presentations

Jettie Vreugdenhil, Donna Döpp, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *The role of illness scripts in nursing expertise; a directed content analysis.* Poster presentation, 2021 LEARN! Conference, Amsterdam, the Netherlands.

Jettie Vreugdenhil, Bea Spek. *Ontwikkeling en validering van de Nederlandse versie van Lasater Clinical Judgement Rubric in de ziekenhuispraktijk: een instrument ontwerp studie.* Oral presentation, 2017 NVMO Conference, Egmond aan Zee, the Netherlands

Jettie Vreugdenhil, Donna Döpp, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *De rol van Illness scripts in de ontwikkeling van verpleegkundige expertise.* Poster presentation, 2019 NVMO Conference, Rotterdam, the Netherlands.

Jettie Vreugdenhil, Sunia Somra, Hans Ket, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *Klinisch redeneren van artsen en verpleegkundigen; een systematische, gelaagde analyse.* Poster presentation, 2022 NVMO Conference, online.

Jettie Vreugdenhil, Louti Broeksma, Carolyn Teuwen, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *Debriefing om de vorming van illness scripts te bevorderen bij studenten verpleegkunde; leren van onze patiënten. Een design-based onderzoek.* Poster presentation, 2023 NVMO Conference, Maastricht, the Netherlands.

Marianne Mak-van der Vossen, Walther van Mook, Jettie Vreugdenhil, José van de Kreeke, Stephan Ramaekers. *Zwijgen is oud, spreken is goud.* Workshop, 2023 NVMO Conference, the Netherlands.

Jettie Vreugdenhil, Sunia Somra, Hans Ket, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *Klinisch redeneren als een arts of als een verpleegkundige? Een 'systematic integrative review'.* Accepted oral presentation, 2024 NVMO Conference, Egmond aan Zee, the Netherlands.

Jettie Vreugdenhil, Sunia Somra, Hans Ket, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *Clinical reasoning like a doctor or a nurse? a systematic integrative review.* Accepted oral presentation, 2024 World Congress on Nursing & Education, Prague, Czech Republic.

Jettie Vreugdenhil, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *Thinking like a doctor or like a nurse? Curiosity is the wick in the candle of learning.* 2019 NET Conference, Keele, United Kingdom.

Jettie Vreugdenhil, Louti Broeksma, Carolyn Teuwen, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *Debriefing om de vorming van illness scripts te bevorderen bij studenten verpleegkunde; leren van onze patiënten. Een design-based onderzoek.* Poster presentatie, 2023 Amsterdam UMC Verpleegkunde congres, Amsterdam, the Netherlands.

Beyke Gazendam, Karlijne van Ammers, Jettie Vreugdenhil. *Flip the staff.* Workshop, 2022 Amsterdam UMC Verpleegkunde congres, Amsterdam, the Netherlands.

Jettie Vreugdenhil, Sunia Somra, Hans Ket, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *Clinical reasoning like a doctor or a nurse? a systematic integrative review.* Oral presentation, 2022 AMEE Conference, Lyon.

Jettie Vreugdenhil, Donna Döpp, Eugène Custers, Marcel Reinders, Jos Dobber, Rashmi Kusurkar. *The role of illness scripts in nursing expertise; a directed content analysis.* Oral Presentation, 2022 European Nursing Conference, online.

Jettie Vreugdenhil. *My PhD story.* Oral pitch, 2022, 20-year anniversary Master Evidence based practice in Healthcare, Amsterdam, the Netherlands

Jettie Vreugdenhil. *Guiding the development of clinical reasoning skills of nursing students in practice, PhD proposal.* Oral presentation, 2021 Platform Nursing research Amsterdam UMC, online.

Summary of training

NAME COURSE, TRAINING, ACTIVITIES	EC	Year
Courses		
Scientific integrity course or research ethics		2020
Presenting and pitching in English		2019
Story telling		2022
Qualitative research		2017
Practical bio statistics	11.29	2022
Events Research Institute, activities, colloquia		
Research in progress		2018-2024
Research integrity conference		
Presentations IOO		
Reference meetings		
Burning questions	9.41	
Congress participation		
AMEE		2018, 2020, 2021
SDT Conference organizing committee		2019
NET conference		2019
NVMO		2017, 2019, 2022, 2023
LEARN!		2019
ENC		2019
Verpleegkunde congres Amsterdam UMC		2020
Lustrum EBP UvA		2022
Professional Behaviour	20,72	2019
Events and Colloquia		
NVMO Colloquia		2018-2023
AMEE classes Exploring the how, what and why of mentoring		2020
NVMO PhD relay		2021
LOOV Fast switch		2022
Erasmus MC Spring!		2020
NVZ Samen berslissen	2,93	2021
Teaching		
Evidence-based practice classes for nursing students		2018-2023
Poster presentations nursing students		2019
Evidence-based practice classes for nurse educators		2018-2023
Providing guidance to nurses and nurse educators on producing critical appraised topics (CAT)		2018-2021
Accreditations InHolland University of applied sciences/ nursing	6,06	2018-2022
Academic		
Tutoring master students		2018-2022
Co-author competencies Samen Beslissen		2021
Work conferences mediating		2020
Co-author didactic principles nursing Amsterdam UMC		2022-2023
Policy formulating academic career paths Amstel Academie		2021
Platform **nursing** research		2021-2024
Organization mock conference presentations	8,6	2018-2024
Total EC	59,1	

About the author

Jettie Vreugdenhil was born in 1962 in Delft to a family of four daughters. After her VWO education in 1980 at the Christelijk Lyceum in Alphen aan den Rijn, she studied psychology for a year at Calvin College, Grand Rapids in Michigan (USA). After this she was admitted to the bachelor's program in nursing at the Gysbrecht Academy in Amsterdam. She then studied nursing science at Maastricht University, but dropped out of these studies to build a family and nursing "career. She worked as a neurology nurse and nurse manager before turning to training nursing students. She completed a master's in teaching at HGZO-VU in Amsterdam (2011) and later a master's in Evidence-based practice in health care at the UvA in Amsterdam (2017). She has worked for over 20 years as a nurse educator and project leader for the Amstel Academy and VU medical center and later Amsterdam University Medical Center. She also started her part-time PhD trajectory in September 2018, supported by her managers. During this PhD trajectory, nursing education in the practice of two large hospitals was merged, and she contributed to this process as educational consultant. Since 2023, she has also been a member of the Ethical Review Board of the Netherlands Association for Medical Education (NVMO). Currently, she still works at Amsterdam UMC, continuing her mission to improve the education of healthcare professionals, informed by research.

She lives with Chris and they share a love for music, art and outdoor activities and, of course, a love for Tom (1995) and Loes (2000).

Appendices

Appendix 1. Full search strategies

Resources

- PubMed
- CINAHL
- PsycInfo
- Clarivate Analytics/ Web of Science

Search strategies

PubMed March 30, 2020 (569)

Search	Query	Items found
#27	(#23 AND #26)	**569**
#33	(#32 NOT #27)	**894**
#32	(#31 AND #23)	**927**
#31	clinical judgement*[tiab] OR clinical judgment*[tiab]	**7156**
#30	(#29 NOT #27)	**1434**
#29	(#28 AND #23)	**1461**
#28	clinical decision making*[tiab]	**16876**
#26	clinical reason*[tiab]	**3973**
#24	(#22 AND #23)	**6965**
#23	"Nurses"[Mesh] OR "Nurse-Patient Relations"[Mesh] OR "Practice Patterns, Nurses'"[Mesh] OR "Schools, Nursing"[Mesh] OR "Nurse's Role"[Mesh] OR "Students, Nursing"[Mesh] OR "Nursing Assistants"[Mesh] OR "Societies, Nursing"[Mesh] OR "Nursing Stations"[Mesh] OR "Nursing"[Mesh] OR "nursing" [Subheading] OR "National Institute of Nursing ReU.S."[Mesh] OR "Nursing Informatics"[Mesh] OR "Models, Nursing"[Mesh] OR "Nursing Research"[Mesh] OR "Nursing Staff"[Mesh] OR "Education, Nursing"[Mesh] OR nurse[tiab] OR nurses[tiab] OR nursing*[tiab] OR jsubsetn	**955248**
#22	(clinical*[tiab] AND ("Decision Making"[Mesh] OR "Judgment"[Mesh])) OR clinical reason*[tiab] OR clinical judgement*[tiab] OR clinical judgment*[tiab] OR clinical decision*[tiab]	**65710**

Revision, PubMed April 15 2020 (1415 nurse, 2501 doctor)

(1 AND 2) OR (1 AND 3)

Search	Query	Items found
#44	#43 NOT #40	**2501**
#43	#36 AND #42	**2722**
#42	"Anesthetists"[Mesh] OR "Physicians"[Mesh] OR allergist*[tiab] OR anaesthesiologist*[tiab] OR anaesthesist*[tiab] OR anesthesiologist*[tiab] OR anesthesist*[tiab] OR cardiologist*[tiab] OR dermatologist*[tiab] OR doctor*[tiab] OR endocrinologist*[tiab] OR gastroenterologist*[tiab] OR general practitioner*[tiab] OR geriatrician*[tiab] OR geriatrist*[tiab] OR gerontologist*[tiab] OR gynaecologist*[tiab] OR gynecologist*[tiab] OR hepatologist*[tiab] OR hospitalist*[tiab] OR house staff*[tiab] OR intensivist*[tiab] OR intern[tiab] OR internist*[tiab] OR interns[tiab] OR internship*[tiab] OR medical speciali*[tiab] OR neonatologist*[tiab] OR nephrologist*[tiab] OR neurologist*[tiab] OR neurologist*[tiab] OR	**1132406**

	neurosurgeon*[tiab] OR obstetrician*[tiab] OR obstaetrician*[tiab] OR oncologist*[tiab] OR ophthalmologist*[tiab] OR orthopedist*[tiab] OR osteopath[tiab] OR osteopaths[tiab] OR otolaryngologist*[tiab] OR otologist*[tiab] OR paediatrician*[tiab] OR pathologist*[tiab] OR pediatrician*[tiab] OR physiatrist*[tiab] OR physician*[tiab] OR pulmonologist*[tiab] OR radiologist*[tiab] OR residencies[tiab] OR residency[tiab] OR resident*[tiab] OR resident[tiab] OR residents[tiab] OR rheumatologist*[tiab] OR surgeon*[tiab] OR urologist*[tiab]	
#41	#40 NOT *[569 PMIDs]*	**901**
#40	#36 AND #39	**1415**
#39	"Nurses"[Mesh] OR "Nurse-Patient Relations"[Mesh] OR "Practice Patterns, Nurses'"[Mesh] OR "Schools, Nursing"[Mesh] OR "Nurse's Role"[Mesh] OR "Students, Nursing"[Mesh] OR "Nursing Assistants"[Mesh] OR "Societies, Nursing"[Mesh] OR "Nursing Stations"[Mesh] OR "Nursing"[Mesh] OR "nursing" [Subheading] OR "National Institute of Nursing Research (U.S.)"[Mesh] OR "Nursing Informatics"[Mesh] OR "Models, Nursing"[Mesh] OR "Nursing Research"[Mesh] OR "Nursing Staff"[Mesh] OR "Education, Nursing"[Mesh] OR nurse[tiab] OR nurses[tiab] OR nursing*[tiab] OR jsubsetn	**956603**
#36	clinical reasoning*[tiab] OR clinical judgement*[tiab] OR clinical judgment*[tiab] OR collaborative reasoning*[tiab]	**10227**

Ebsco/CINAHL April 30, 2020 (2191 nurse, 1214 doctor)

#	Query	Results
S8	S6 NOT *[2501 PMIDs]*	**659**
S7	S3 NOT *[1415 PMIDs]*	**1,590**
S6	S5 NOT S3	**1,214**
S5	S1 AND S4	**1,436**
S4	MH "Physicians+" OR MH "Pathologists+" OR MH "Anesthetists" OR TI(allergist* OR anaesthesiologist* OR anaesthesist* OR anesthesiologist* OR anesthesist* OR cardiologist* OR dermatologist* OR doctor* OR endocrinologist* OR gastroenterologist* OR "general practitioner*" OR geriatrician* OR geriatrist* OR gerontologist* OR gynaecologist* OR gynecologist* OR hepatologist* OR hospitalist* OR "house staff*" OR intensivist* OR intern OR internist* OR interns OR internship* OR "medical speciali*" OR neonatologist* OR nephrologist* OR neurologist* OR neurosurgeon* OR obstetrician* OR obstaetrician* OR oncologist* OR ophthalmologist* OR orthopedist* OR osteopath OR osteopaths OR otolaryngologist* OR otologist* OR paediatrician* OR pathologist* OR pediatrician* OR physiatrist* OR physician* OR pulmonologist* OR radiologist* OR residencies OR residency OR resident* OR resident OR residents OR rheumatologist* OR surgeon* OR urologist*) OR AB(allergist* OR anaesthesiologist* OR anaesthesist* OR anesthesiologist* OR anesthesist* OR cardiologist* OR dermatologist* OR doctor* OR endocrinologist* OR gastroenterologist* OR "general practitioner*" OR geriatrician* OR geriatrist* OR gerontologist* OR gynaecologist* OR gynecologist* OR hepatologist* OR hospitalist* OR "house staff*" OR intensivist* OR intern OR internist* OR interns OR internship* OR "medical speciali*" OR neonatologist* OR nephrologist* OR neurologist* OR neurosurgeon* OR obstetrician* OR obstaetrician* OR oncologist* OR ophthalmologist* OR orthopedist* OR osteopath OR osteopaths OR otolaryngologist* OR otologist* OR paediatrician* OR pathologist* OR pediatrician* OR physiatrist* OR physician* OR pulmonologist* OR radiologist* OR residencies OR residency OR resident* OR resident OR residents OR rheumatologist* OR surgeon* OR urologist*) OR KW(allergist* OR anaesthesiologist* OR anaesthesist* OR anesthesiologist* OR anesthesist* OR cardiologist* OR dermatologist* OR doctor* OR endocrinologist* OR gastroenterologist* OR "general practitioner*" OR geriatrician* OR geriatrist* OR gerontologist* OR gynaecologist* OR gynecologist* OR hepatologist* OR hospitalist* OR "house staff*" OR intensivist* OR intern OR internist* OR interns OR internship* OR "medical speciali*" OR neonatologist* OR nephrologist* OR neurologist* OR	**474,914**

	neurosurgeon* OR obstetrician* OR obstaetrician* OR oncologist* OR ophthalmologist* OR orthopedist* OR osteopath OR osteopaths OR otolaryngologist* OR otologist* OR paediatrician* OR pathologist* OR pediatrician* OR physiatrist* OR physician* OR pulmonologist* OR radiologist* OR residencies OR residency OR resident* OR resident OR residents OR rheumatologist* OR surgeon* OR urologist*)	
S3	S1 AND S2	**2,191**
S2	MH "Nurses+" OR MH "Nurses by Educational Level+" OR MH "Nurses by Role+" OR MH "Pediatric Nurse Practitioners+" OR MH "Nurse Practitioners+" OR MH "Advanced Practice Nurses+" OR MH "Nurse Administrators+" OR MH "Nurse Managers+" OR MH "Nurse Consultants+" OR MH "Nurses by Specialty+" OR MH "Nurses, Other+" OR MH "Nursing Manpower+" OR MH "Nurse-Patient Relations" OR MH "Academy of Neonatal Nursing" OR MH "Addictions Nursing" OR MH "Advanced Nursing Practice" OR MH "Nursing Administration Research" OR MH "Specialties, Nursing+" OR MH "Community Health Nursing+" OR MH "Emergency Nursing+" OR MH "Maternal-Child Nursing+" OR MH "Neonatal Nursing+" OR MH "Pediatric Critical Care Nursing+" OR MH "Pediatric Nursing+" OR MH "Medical-Surgical Nursing+" OR MH "Dermatology Nursing+" OR MH "Critical Care Nursing+" OR MH "Cardiovascular Nursing+" OR MH "Gerontologic Nursing+" OR MH "Neuroscience Nursing+" OR MH "Oncologic Nursing+" OR MH "Surgical Nursing, Plastic+" OR MH "Wound, Ostomy and Continence Nursing+" OR MH "Psychiatric Nursing+" OR MH "Nursing Care" OR MH "Schools, Nursing" OR MH "Students, Nursing+" OR MH "Students, Nursing, Baccalaureate+" OR MH "Students, Nursing, Graduate+" OR MH "Students, Nursing, Practical" OR MH "Nursing Assistants" OR MH "Nursing Organizations+" OR MH "Nursing Organizations, International+" OR MH "State Boards of Nursing+" OR MH "State, Provincial and Territorial Nursing Organizations+" OR MH "State Nursing Organizations+" OR MH "Nursing Informatics" OR MH "Nursing Theory+" OR MH "Nursing Models, Theoretical+" OR MH "King Open Systems Model+" OR MH "Education, Nursing, Research-Based" OR MH "Clinical Nursing Research" OR MH "Research, Nursing" OR MH "Nursing Staff, Hospital" OR TI(nurse OR nurses OR nursing*) OR AB(nurse OR nurses OR nursing*) OR KW(nurse OR nurses OR nursing*)	**832,526**
S1	MH "Diagnostic Reasoning" OR (MH "Judgment" AND (TI(clinical) OR AB(clinical) OR KW(clinical)) OR TI (“clinical reasoning*” OR “clinical judgement*” OR “clinical judgment*” OR “collaborative reasoning*”) OR AB (“clinical reasoning*” OR “clinical judgement*” OR “clinical judgment*” OR “collaborative reasoning*”) OR KW (“clinical reasoning*” OR “clinical judgement*” OR “clinical judgment*” OR “collaborative reasoning*”)	**8,089**

Ebsco/APA PsycInfo May 1, 2020 (968 nurse, 1774 doctor)

Search ID#	Search Terms	Actions
S8	S6 NOT *[2501 PMIDs]*	**1,500**
S7	S3 NOT *[1415 PMIDs]*	**738**
S6	S5 NOT S3	**1,774**
S5	S1 AND S4	**1,965**
S4	DE "Physicians" OR DE "Family Physicians" OR DE "General Practitioners" OR DE "Gynecologists" OR DE "Internists" OR DE "Neurologists" OR DE "Obstetricians" OR DE "Pathologists" OR DE "Pediatricians" OR DE "Psychiatrists" OR DE "Surgeons" OR TI(allergist* OR anaesthesiologist* OR anaesthesist* OR anesthesiologist* OR anesthesist* OR cardiologist* OR dermatologist* OR doctor* OR endocrinologist* OR gastroenterologist* OR “general practitioner*” OR geriatrician* OR geriatrist* OR gerontologist* OR ...	**207,742**
S3	S1 AND S2	**968**
S2	DE "Nurses" OR DE "Psychiatric Nurses" OR DE "Public Health Service Nurses" OR DE "School Nurses" OR DE "Nursing" OR DE "Nursing Students" OR DE	**97,210**

	"Nursing Education" OR TI(nurse OR nurses OR nursing*) OR AB(nurse OR nurses OR nursing*) OR KW(nurse OR nurses OR nursing*)	
S1	DE "Inductive Deductive Reasoning" OR DE "Reasoning" OR DE "Inference" OR DE "Clinical Judgment (Not Diagnosis)" OR DE "Probability Judgment" OR (DE "Judgment" AND (TI(clinical) OR AB(clinical) OR KW(clinical)) OR TI("clinical reasoning*" OR "clinical judgement*" OR "clinical judgment*" OR "collaborative reasoning*") OR AB("clinical reasoning*" OR "clinical judgement*" OR "clinical judgment*" OR "collaborative reasoning*") OR KW("clinical reasoning*" OR "clinical judgement*" OR "clinical judgmen ...	**36,164**

Clarivate Analytics/Web of Science Core Collection 27 May 27, 2020 (1123 nurse, 2174 doctor)

Set	Results	Query
#8	**461**	#7 NOT *[2501 PMIDs]*
#7	**2,174**	#6 NOT #3
#6	**2,383**	#1 AND #5
#5	**1,091,016**	TOPIC: ("allergist*" OR "anaesthesiologist*" OR "anaesthesist*" OR "anesthesiologist*" OR "anesthesist*" OR "cardiologist*" OR "dermatologist*" OR "doctor*" OR "endocrinologist*" OR "gastroenterologist*" OR "general practitioner*" OR "geriatrician*" OR "geriatrist*" OR "gerontologist*" OR "gynaecologist*" OR "gynecologist*" OR "hepatologist*" OR "hospitalist*" OR "house staff*" OR "intensivist*" OR "intern" OR "internist*" OR "interns" OR "internship*" OR "medical speciali*" OR "neonatologist*" OR "nephrologist*" OR "neurologist*" OR "neurosurgeon*" OR "obstetrician*" OR "obstaetrician*" OR "oncologist*" OR "ophthalmologist*" OR "orthopedist*" OR "osteopath" OR "osteopaths" OR "otolaryngologist*" OR "otologist*" OR "paediatrician*" OR "pathologist*" OR "pediatrician*" OR "physiatrist*" OR "physician*" OR "pulmonologist*" OR "radiologist*" OR "residencies" OR "residency" OR "resident*" OR "resident" OR "residents" OR "rheumatologist*" OR "surgeon*" OR "urologist*")
#4	**337**	#3 NOT *[1415 PMIDs]*
#3	**1,123**	#2 AND #1
#2	**286,740**	TOPIC: ("nurse" OR "nurses" OR "nursing*")
#1	**9,377**	TOPIC: ("clinical reasoning*" OR "clinical judgement*" OR "clinical judgment*" OR "collaborative reasoning*")

Appendix 2. Quality assessment

Reviewer 1				
Reviewer 2				
Author (s)				
Methods				
Study design				
Data				
Sampling				
Analysis				
Research question				
Types of Study	**Methodological Quality assessment Criteria**	**Yes**	**No**	**Can't tell**
Screening Questions (for all types)	Are there clear research questions or objectives?	☐	☐	☐
	Do the collected data address the research question?	☐	☐	☐
	Further appraisal is not feasible when the answer is 'No' or 'Can't tell' to one or both screening questions			
Qualitative	1.1 Is there congruity between the stated philosophical perspective and the research methodology?	☐	☐	☐
	1.2 Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question?	☐	☐	☐
	1.3 Is the process for analysing qualitative data relevant to address the research question?	☐	☐	☐
	1.4 Are participants, and their voices, adequately represented? (adequate quotes and text been used to represent the concept discussed)	☐	☐	☐
	1.5 Is there a statement locating the researcher culturally or theoretically? (Are the beliefs and values, and their potential influence on the study declared?)	☐	☐	☐
	1.6. Is the influence of the researcher on the research, and vice-versa, addressed? *(Addressing the potential for the researcher to either influence or to be influenced by the study)*	☐	☐	☐
	1.7. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	☐	☐	☐
	1.8. Is the ethical issues adequately addressed? *(statement indicating appropriate ethics approval)*	☐	☐	☐
Quantitative randomized controlled (trials)	2.1. Is there a clear description of the randomization (or an appropriate sequence generation)?	☐	☐	☐
	2.2. Is there a clear description of the allocation concealment or blinding when applicable)?	☐	☐	☐
	2.3. Are there complete outcome data (80% or above)?	☐	☐	☐
	2.4. Is there low withdrawal/drop-out (below 20%)?	☐	☐	☐
Quantitative non-randomized	3.1. Are participants recruited in a way that minimizes selection bias?	☐	☐	☐
	3.2 Were the criteria for inclusion in the sample clearly defined?	☐	☐	☐
	3.3 Were the study subjects and the setting described in detail?	☐	☐	☐
(Cohort study, case-control study, analytical cross-sectional)	3.4 Were objective, standard criteria used for measurement of the condition?	☐	☐	☐
	3.5 Were the outcomes measured in a valid and reliable way?	☐	☐	☐
	3.6 Was appropriate statistical analysis used?	☐	☐	☐
	3.7 Is the ethical issues adequately addressed? (statement indicating appropriate ethics approval)	☐	☐	☐

	3.8 Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	☐	☐	☐
	3.9 Are measurements appropriate (clear origin, or validity known, or standard instrument; and absence of contamination between groups when appropriate) regarding the exposure/intervention and outcomes?	☐	☐	☐
	3.10 In the groups being compared (exposed vs. non-exposed; with intervention vs. without; cases vs. controls), are the participants comparable, or do researchers take into account (control for) the difference between these groups?	☐	☐	☐
	3.11 Are there complete outcome data (80% or above), and, when applicable, an acceptable response rate (60% or above), or an acceptable follow-up rate for cohort studies (depending on the duration of follow-up)?	☐	☐	☐
Quantitative descriptive	4.1. Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?	☐	☐	☐
	4.2. Is the sample representative of the population understudy?	☐	☐	☐
	4.3. Are measurements appropriate (clear origin, or validity known, or standard instrument)?	☐	☐	☐
	4.4. Is there an acceptable response rate (60% or above)?	☐	☐	☐
Systematic Review	5.1 Is the review question clearly and explicitly stated?	☐	☐	☐
	5.2 Were the inclusion criteria appropriate for the review question?	☐	☐	☐
	5.3 Was the search strategy appropriate?	☐	☐	☐
	5.4 Were the sources and resources used to search for studies adequate?	☐	☐	☐
	5.5 Were the criteria for appraising studies appropriate?	☐	☐	☐
	5.6 Was critical appraisal conducted by two or more reviewers independently?	☐	☐	☐
	5.7 Were there methods to minimize errors in data extraction?	☐	☐	☐
	5.8 Were the methods used to combine studies appropriate?	☐	☐	☐
	5.9 Was the likelihood of publication bias assessed?	☐	☐	☐
	5.10 Were recommendations for policy and/or practice supported by the reported data?	☐	☐	☐
	5.11 Were the specific directives for new research appropriate?	☐	☐	☐
Mixed methods	6.1. Is the mixed methods research design relevant to address the qualitative and quantitative research questions, or the qualitative and quantitative aspects of the mixed methods question?	☐	☐	☐
	6.2. Is the integration of qualitative and quantitative data (or results relevant to address the research question?	☐	☐	☐
	6.3. Is appropriate consideration given to the limitations associated with this integration, e.g., the divergence of qualitative and quantitative data in a triangulation design?	☐	☐	☐
	Apply the criteria use for qualitative data for the qualitative component and quantitative component respectively.			

Text and Opinion	*7.1. Is the source of opinion clearly defined?*	☐	☐	☐
	7.2. Does the source of opinion have standing in the field of expertise?	☐	☐	☐
	7.3. Are the interests of the relevant population the central focus of opinion?	☐	☐	☐
	7.4. Is the stated position the result of an analytical process, and is there logic in the opinion expressed?	☐	☐	☐
	7.5 Is there reference to the extant literature?	☐	☐	☐
	7.6. is any incongruence with the literature/sources logically defended?	☐	☐	☐
Overall Quality Score	*Comments on score:*	☐ Low (25%) ☐ Medium (50%) ☐ High 75% - 100%		

Based on: Badu, E., O'Brien, A. P., & Mitchell, R. (2018). An integrative review of potential enablers and barriers to accessing mental health services in Ghana. *Health Res Policy Syst, 16*(1), 110. https://doi.org/10.1186/s12961-018-0382-1

and JBI critical appraisal checklist for text and opinion papers 2017
http://joannabriggs.org/research/critical-appraisal-tools.html

Appendix 3 Validity matrices

The blue cells contain findings that were common to the two professions and the pink cells contain findings that were in contrast between the two professions. The red data elements in the cells were found only in either nursing or medical literature.

Medicine		Nursing
Professional paradigms		
Based on 24 studies		
'doing the doctor thing' (diagnose and treatment) [1] Hippocratic or medical healthcare paradigm: diagnosis, treatment, privacy [2] To manage diagnostic uncertainty [3] The healing relationship between patient and physician [4]	**Cure**	To execute residents' decisions, to indicate observations and concerns [5]
A call for a shift in clinical care away from underlying disease pathology [6] Functional health paradigm [2] Primary care has a broad, generalist scope with a focus on continuity and recognizes psychosocial factors in process and outcome of health problems [7] Pragmatic approach [8]	**Care**	'Doing the nurse thing': attending to patient needs [1] Attitudes and philosophy of encompassed caring [9-12], directed to the concerns of the individual, family or community client system [13] Nurse are not involved in reaching a diagnosis or making management decisions, according to residents [5] Primary care and total client care [14, 15] The importance of comfort [16] The responses of persons, groups or communities toward health problems or vital processes [17] Pragmatism paradigm [18]
Popperian, analytical approach [8, 19] 3rd person knowing, objective, generalizable, abstracted from context [6, 20] Clinicians are Bayesians by nature [21] Is the body a machine?[22] Epistemic approach [8] Biomedical, disease model [6, 7, 23] Scientific rigour [19], Evidence based approach [23]	**Objective**	Positivist approach does not fit nursing [15] Empirical paradigm [18]
Understanding people and their experience of disease [6] Second person knowing, intersubjectivity, links objective and subjective [6] Situated clinical knowledge, temporary, relative and individualized [24] Medical practice is a hermeneutical enterprise [24] Is the physician a neutral observer? [20] Clinical medicine is a relationship between two individuals [4] psychosocial illness model [7, 23] Clinical relevance [19], medical practice is not the same as medical science [22, 24] Act for the individual patient [4]	**Subjective**	Interpretive paradigm [18] The client's and his/her own perceptions [13] The intention to humanize and personalize care [16] Care requires interpretation, understanding and hermeneutic experience [12] Commitment, empowerment, self-awareness and holism [9] Patient centered care [1, 10]
Patient as a partner, or passive [23] Privacy contract between patient and physician [2] Patient not necessarily involved in clinical reasoning [14] Intersubjectivity [6]	**Relation to patient**	The ethic for disclosure to patients and families [16] Patient is involved in reasoning [14]

Medicine		Nursing
Underpinning theories		
Based on 36 studies		
Information processing theory [8, 25-28] Script or schema theory [27, 29, 30] Exemplar theory [31, 32] Prototype theory [31, 32] Fuzzy trace theory [19],	**Memory and cognition**	Information processing theory [10, 11, 26, 33-37]. Lee et al [15] question the value of this theory not only logic, objectivity and rationality but also emotions, affect and context) Script or schema theory [11, 33]
Dual (cognition) process theory [6, 19, 21, 26-28, 30, 38-42] Cognitive Continuum theory [19, 21, 43] Skills acquisition theory Dreyfus [21, 28] Bounded rationality [41, 44] Theory of heuristic strategies [19]	**Rationality, intuition and analysis,**	Dual (cognition) process theory [26, 45] Cognitive Continuum theory [43, 46-48] Skills acquisition theory Dreyfus [33] Dreyfus and Dreyfus model of intuitive judgment [15, 33]
Situativity theory [25, 27] Cognitive load theory [25, 27], Dual Coding theory of Paivio [49], Gallagher's interactional theory [6], virtue epistemology [6], belief formation theory, [6] Lonergan's theory of knowing, [24] Dialogism [22]	**Perception and interaction**	Situativity theory [50] Schon's reflection on action [9], Social judgment theory [47]

Medicine		Nursing
Intentions of clinical reasoning		
Based on 34 studies		
To establish a diagnosis [5, 6, 14, 25, 27, 30, 34, 38, 41, 51, 52] with a strong focus on etiology [5], biological alterations [14] Problem construction [8] To predict [14, 42]	**To diagnose or assess**	To establish or identify a diagnosis [5] actual and potential patient problems [10, 26, 33, 34, 37, 50] Problem construction of current (constantly changing) condition or situation [26, 53]
To decide on a plan of actions [5, 8, 22, 25, 27, 51, 54] Admission decisions [38] Treatment [6, 14, 26, 30, 41, 42, 55] To prevent [39] To monitor the patient [5]	**Patient management**	To decide on a plan of actions [5, 36, 37, 48, 54] To prevent [13, 33, 50] To monitor the patient [5]
To explain to the patient [5, 14, 26, 53] To understand patient's problems [6, 20]	**To understand and explain**	To explain to the patient [5] To understand the symptom and its impact on the patient [5, 37]
To reduce uncertainty [3, 56] To develop hypotheses and theories [8, 42]	**To enlarge knowledge**	To manage uncertainty [57] To improve competent nursing practice [36, 45, 58]
To communicate interprofessionally and reach a shared mental model about patients problem and management [5]	**To collaborate**	To communicate interprofessionally and reach a shared mental model about patients problem and management [5] To promote nursing autonomy [45]
To improve patient outcomes [6, 38, 39] To improve care [59]	**To achieve**	To improve patient outcomes[13, 33, 34, 36, 37, 45, 48, 54, 57] To improve care [45, 48])
Framing the encounter[51]	**To frame**	

Medicine		Nursing
What, content, domain		
Based 31 studies		
Disease, illness, problems, symptoms, progress, pathophysiology [6, 14, 15, 19-21, 25, 26, 28, 43, 60] Complaints [8, 24] Health, appearance, environment [38, 44] *"The doctor must come to know the patient's body as a biomedical object, but must also reach an understanding with the patient as a fellow human being…Both are necessary and both should be used in balance"*[22]	**focus**	Disease, illness, problems, symptoms, progress, pathophysiology [16, 26, 50, 58] Needs, concerns, emotions and feelings [1, 5, 13, 45, 48] Clinical situation, health status, strengths and resources, psychosocial condition [5, 13, 15, 16, 26, 34, 45, 54, 58, 61] Responses to health problems, risks [5, 16, 50, 61]
	Clientele	Also client system, community [13, 14, 16, 26]

Medicine		Nursing
Antecedents of clinical reasoning		
Based on 54 studies		
Clinical experience [5, 21, 25, 27, 28, 39, 40, 52, 55, 60, 62, 63]	**Professional experience**	Clinical experience [5, 9, 11, 15, 16, 33, 34, 36, 37, 48, 54, 64], The role of experience is not fully understood [45, 64]
Knowledge [5, 21, 27, 29, 30, 49, 59, 63] Formal knowledge of biomedicine, epidemiology, social and human sciences, of signs, symptoms, causes, pathophysiological mechanisms, treatments, drugs, of local services [20, 21, 39, 42, 55, 63] Encapsulated knowledge [21, 31, 59] Domain or discipline specific knowledge [32, 40] Informal, tacit knowledge [5, 20-22, 39] Organized knowledge (patterns, scripts) [25, 28-30, 32, 42, 55, 62] Physicians use more theoretical knowledge [26]	**Knowledge**	Knowledge [5, 11, 15, 34, 54], integrative knowledge from different areas [45], Formal knowledge of physiology, pathophysiology, pharmacology, epidemiology, therapeutics, culture, context of care, ethics and law etc. as well as an understanding of evidence based practice [11, 16, 33, 34, 45, 48, 50, 57, 58, 64] Encapsulated knowledge [61] Domain or discipline specific knowledge [15, 34, 36, 37, 57, 61] Informal, tacit knowledge [5, 9, 11, 16, 34] Organized knowledge (patterns, scripts)[9-11, 58] Procedural knowledge [33, 34, 48] Nurses use more personal knowledge [26]
(early) Patient data [8, 20, 30, 38, 40], contextual data [20, 41] Diagnostic uncertainty [38]	**Trigger**	(early) Patient data [10, 16, 34, 35, 50, 54, 57] Patient's needs [11]
Task characteristics, complexity [19, 21, 28, 32, 40] Characteristics of the illness: [5, 19, 25, 39, 42, 52, 63]	**Characteristics task**	Task characteristics, complexity [15, 16, 34, 47] Characteristics of the situation [9, 34]
Metacognition and logic [8, 19, 20, 24, 30, 42, 62], Intuition [20] Memory and retrieval [32] Perception and situational awareness [5, 6, 52, 56, 60], alertness [60] **Personal**: Emotions [6, 21, 55, 60, 65], affect [21], Motivation [30, 56, 60], Level of confidence [5, 44], Self-knowledge [6], Age, sex, training, beliefs, fear of litigation, risk aversion [40], ability to deal with diagnostic uncertainty [39, 40], cognitive load [19, 25, 40, 56], general approach, as an interventionist or gradualist [43] emotional intelligence [65], mastery of rhetoric and language [22]	**Characteristics professional**	Metacognition and logic [11, 16, 33, 34, 36] Intuition [11, 35, 54] Memory and retrieval [33, 34, 54] Perception and situational awareness [5, 15, 33, 34], Sense of salience [11, 33, 35, 57] **Personal,** "*What the nurse brings to the situation*" [16, 57, 58] general approach, as an interventionist or gradualist [43] a questioning attitude [13, 17], the ability to manage trust, knowledge and skills simultaneously in the situation with the patient [12] attention, concentration, motivation [13, 45]
Rapport with patient [24, 27, 39, 52, 55], intersubjectivity [6] Knowing the patient [5, 6] Team [5]	**Relations**	Rapport with patient [9, 15, 37, 48, 54, 58, 64, 66], mutual trust [12, 43] Knowing the patient [5, 9, 15, 16, 43, 58, 64] Team [5] (Interdisciplinary) relationships power, inequity, role expectations [15, 16, 33]

Medicine		Nursing
Attributes and strategies of clinical reasoning		
Based on 55 studies		
Recognition [19], Similarity recognition, [31, 59]. pattern recognition on few cues [19, 21, 24, 27, 31, 38, 42, 43, 52, 55, 62], based on specific instances or general prototypes [32] Recognized patterns are followed by guided search using your slower, sequential reasoning brain to match patterns [60] **Perception** of the features of the situation that trigger scripts [29], to notice and to discriminate between right and wrong and (un)similarity. Perception and cognition are integrated [60] **Memory** direct retrieval by categorization and problem representation [31, 55] Scripts and schemes, [25, 29, 42] **Intuition** [19, 43, 60, 62], first impressions [40], instantaneous formulations [39], intuitive knowing is based on experience, understanding and judging [24], bounded rationality [19] **Interaction of intuitive and analytical cognition** [6, 19, 22, 24, 27, 38, 52] **Reflection** [24]	**Use of cognition: memory, perception, attention, recognition, intuition**	**Recognition** [9, 10, 17, 45], similarity recognition [18, 33, 64], pattern recognition [10, 11, 16, 33, 34, 37, 43, 47, 57], based on instances or general types [16] **Perception** noticing [16, 45, 58] **Memory**, scripts [11] information processing [34], recall knowledge [33, 50] **Intuition** [34], quasi rationality [47] **Interaction of intuitive and analytical cognition** [11, 45, 47, 48, 50, 58], cognition and metacognition [54, 58] **Reflection** [16, 58]
Assessment Starting point of reasoning: signs and symptoms [5, 56, 62] to clarify issues and priorities [39, 41], to detect changes [5] environmental cues [44], pre-reflexive experiences and imaginations of the GP related to the patient's presentations guide assessment [24], environment and interaction are true variance [27] **Risk** assessment [30, 39] **Interpretation and integration of data** [8, 43, 56, 62] from complaint to solution [8], through interaction and perception [24], connecting similarity with causal explanations [60], chunking data by semantic qualifiers [27], inferring from pattern to illness script [60]. To describe data in verbally in logical, causal explanations [60] into clinical vocabulary [67] Use probability thresholds [19, 30]	**Data analysis and interpretation**	**Assessment** Search and evaluate clinical and other data [5, 10, 11, 34, 37, 48] of the patient and the environment [34], to detect changes, feelings, emotions and general condition of the patient [5], to identify cues, diagnoses, re-evaluate data, identifying missing information[35] **risk f**actors [35], distinguishing normal form abnormal and relevant form irrelevant data [35, 48] **Interpretation and integration of data** [10, 16, 35, 43, 45, 47, 48, 50, 54, 57, 58], intentional judgment [17, 35, 45], forming relationships (assertions) [37], framing [11], with simultaneously planning interventions [36] problems and interventions are viewed as linked entities [33]
Hypothetical reasoning, formulating hypotheses [5, 21] and subsequent paths for elaboration [20] initial set of working hypotheses [14] **Hypothetico-deductive reasoning** [5, 19, 27, 28, 34, 38, 43, 52, 55, 60] **Hypothesis generation** (divergence of hypotheses) [56] , by intuitive processes [28, 29, 40] **Hypothesis testing** [21, 24] a strategy of confirming hypotheses [32, 44], ruling out serious illnesses, ruling in common and safe conditions [29, 39]	**Generation of hypothesis or alternatives**	**Hypothetico-deductive reasoning**, [9, 10, 16, 43] **Hypothesis generation**, [11, 48, 54, 61], early [9], by hypothetico abductive reasoning (to generate specific theories to explain individual cases from our own, personal tacit knowledge about those cases.' [9] Generation of alternatives [54] **Hypothesis testing** [18] testing predictions [37] **Formulating hypotheses** [5, 10, 34]. These are hypothesis –candidates (because they are without some form of causality or predictive power) [14], identifying assumptions [35, 37]
Logic Inferential methods of induction, deduction and abduction [6], to find the best explanation or justification [14], an inductive approach is effective for exploratory tasks that do not have distinct goals, while a deductive approach is more useful for diagnostic and classification tasks [42] Inductive/forward, from current to ideal state is related to system 1 strategies [19, 42], deductive/backwards, from desired result to current situation, a goal-drive approach, testing hypothesis, related to system 2. [19, 42], to apply general principles to specific cases [32], Malterud calls this practical reasoning [20] Abduction in the context of justification [14] **Heuristics** and mental shortcuts, [19, 24, 28], simple, general and hypothesis specific heuristics, anchor [44] or affect heuristic [21] gestalt effect [19]	**Cognitive strategies, heuristics, inferences, approaches**	**Logic** [34], deliberate rationality [33], making inferences [17, 35, 45, 47, 54, 64] , induction and deduction [34, 35, 37, 61], deduction, when testing hypotheses [18], induction [10, 11], to simultaneously assemble and evaluate patient information and supportive evidence [11], to choose management [18] Abduction, inference to the best explanation inferring causal mechanisms, and hypothesis generation [18] in the context of discovery [14], cause and effect assertions [11] **Heuristics** [9-11, 34, 37, 54], to speed reasoning processes [36], or to estimate probability [61] rule of thumb, availability, anchoring [10], clinical Grasp [57] common sense understanding [33] **Nonanalytic, system 1 strategies**

Nonanalytic, system 1 strategies [30, 39], in the initial stage of the encounter [55] pattern matching [28, 32], gut feelings, often limited *to prognostic assessments of the patient's situation and are often accompanied by bodily sensations, a sense of alarm and a sense of reassurance* [21]*, gut feelings based on interaction between patient information and GP's knowledge and experience,* intersubjectivity [6], experiential-inductive approach, modular responsivity [19] **Analytic, system 2 strategies** [6, 27, 30, 39] abstract, decontextualized, and rational approach to clinical problem-solving [6], categorization [6, 31, 32], problem construction [8], aetiology-based reasoning [5], causal reasoning [21] **Approaches** To generate meaning through interaction [22, 38, 39] Checking accuracy of mental representations [41] Backwards or forwards reasoning [29, 39] Reflective diagnostic time out [38], Distraction [38] Relational strategies: analogy (similarity), anomaly (discrepancy/unusualness), antinomy (incompatibility), antithesis (opposition), as a metacognitive means to switch between system 1 and 2 thinking [30] Bayesian thinking [19, 30] Error-checking strategies, to think of other possibilities or interpretations of data [31] Checkpoint strategies, with a focus on red flags [38, 39] therapeutic reasoning [55]		Informal thinking strategies: setting priorities, making generalizations [34], narrative thinking, routine thinking [64], fast and frugal reasoning [68], pattern matching, empathizing, developing a bigger picture and balancing preferences with differences [9], intuitive clinical reasoning [9, 10, 16, 43, 47, 48, 57, 64]. Intuition is a function of experience [61] and difficult to verbalize and explain [50] **Analytical, system 2 strategies** [33, 45, 47, 50, 57, 64]**,** to link cues to categories, classification process, with a probabilistic relationship between cues and class, as an exemplar or a prototype [11, 36, 37, 61], theoretical reasoning [11] **Approaches** Diagnostic reasoning [11, 16]**,** problematic reasoning [11] deliberation [54]**,** pondering [37] , operational reasoning [11] backwards reasoning [46] Narrative thinking, trying to understand the particular [16] Predictive reasoning [9] Responding, acting [16, 58] Making personal connection [37]
Non-linear [24, 27, 38, 55] Context-specific and case specific [27] As an individual or collaborative process to communicate and to share and integrate knowledge [56] As a process [24, 38, 51, 56, 69]	**Process**	Non-linear [33-35, 48, 50] Context-dependent and domain-specific [33, 34] Reactive or proactive [37] As a Process [16, 33, 35, 36, 50, 58]

Medicine		Nursing
Outcomes		
Based on 27 studies		
Diagnosis [1, 21, 24, 27, 56, 62], prioritized problem list, differential diagnosis [25]	**Diagnosis**	Diagnosis of actual and potential problems [35]empirical generalizations [14] clinical diagnoses [5], an accurate picture of current condition or situation [53]
Clinical decisions [39, 40], decisions about discharge, admission [38, 40], diagnostic disclosure [39, 44]	**Decisions**	Clinical decisions [33, 34, 37, 48, 54, 57, 61], decision to alert residents [5]
Treatment or management plan [8, 14, 21, 25, 27, 40, 56, 63], Referrals [52, 63]	**Management**	Choice of action [34, 45, 54, 57, 58], care plan [5, 10, 35]
Prognosis [14, 21, 63]	**Prognosis**	Prognosis [35, 37]
Judgement of the urgency of approach [38, 41]	**Judgment**	Judgement [34, 37, 54], of degree of urgency [5]
Team effectiveness [5]	**Collaboration**	Team effectiveness [5]
To provide explanations to patients to confirm the management plans [5]	**Explanations**	To provide explanations to patients about procedures [5, 37] Justification for decisions [45]
	New knowledge	Reflection and learning [57]

Medicine		Nursing
Contextual factors		
Based on 22 studies		
Context of the patient [21, 44] Patient expectations and preferences [40, 52, 63] Patient characteristics [19, 25, 40, 63] Relationship and barriers [19, 25, 40, 63]	**Patient-related factors**	Context of the patient [34] Patient characteristics [35]
Care context and work environment [19, 27, 32, 40, 51] Resources and legal issues [19, 40, 52, 63] Time aspects and workload [19, 25, 38, 40, 56]	**Environment-related factors**	Care context and work environment [9, 11, 16, 34, 35, 58] Culture and social context of the unit/team [16, 33, 58, 61, 64] Time aspects and workload [9, 34, 64, 68]

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Appendix 4. Mind map analysis

Quantitative		
No. of terms (1)		
No. of links/connections (1)		
No. of cross links (1)		
No. of linking words (2)		
No. of levels (3)		
Qualitative		
Design (1, 3)	☐ Chain ☐ Spoke/spider ☐ Network ☐ Other	
Level of detail (4, 5)	Narrative appraisal	Qualification: ☐ Less than expected ☐ Expected
Logical flow (5)	Narrative appraisal	Qualification: ☐ Less than expected ☐ Expected
Complexity (5)	Narrative appraisal	Qualification: ☐ Less than expected ☐ Expected
Hierarchy (2, 5)	Narrative appraisal	Qualification: ☐ Less than expected ☐ Expected
Content		
Central concept	☐ Disease ☐ Treatment ☐ Patient problem ☐ Other	
Richness (6)	☐ Signs and symptoms ☐ Epidemiology ☐ Management ☐ Aetiology ☐ Impact ☐ Boundary ☐ Other	
Study year		
	☐ 2 ☐ 3 ☐ 4	

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