Clinical reasoning by pharmacists: fostering clinical decision-making and interprofessional collaboration in pharmacy practice and education

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Chapter 1

General introduction

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Pharmacists play a critical role in ensuring safe and effective pharmacotherapy. Cases like the one described below highlight the importance of clinical reasoning by pharmacists and the value of interprofessional collaboration (IPC). This thesis explores how pharmacists make clinical decisions and how education could foster their competence development in clinical reasoning and IPC.

A 78-year-old woman visits the community pharmacy after seeing her general practitioner, who prescribed her diclofenac, a non-steroidal anti-inflammatory drug (NSAID), for arthritis. The pain in her hands prevents her from working in the garden, a hobby that she deeply enjoys. Upon reviewing the prescription, the pharmacist notices that no gastric protection was prescribed alongside diclofenac. Recognizing that older adults using NSAIDs face an increased risk of gastrointestinal complications—such as perforation, ulcers, or bleeding—the pharmacist considers the potential benefits of adding gastric protection, such as pantoprazole, to reduce these risks. Based on established agreements with the general practitioner, the pharmacist is authorized to autonomously dispense gastric protection when clinically indicated. Before proceeding, the pharmacist engages the patient in a consult to explain the risks and benefits of pantoprazole, explore alternative analgesic options (e.g. paracetamol or a topical NSAID), and understand her preferences. Through this shared decision-making, the patient agrees, and the pharmacist dispenses pantoprazole alongside the diclofenac.

What goes through the pharmacist's mind when addressing this patient case? How does the pharmacist identify potential risks and benefits in this situation? What cognitive steps shape the pharmacists' clinical decision-making process when considering the most appropriate pharmacotherapeutic treatment? Which factors influence this process? And how can educators better support pharmacists and pharmacy students in addressing cases like this, fostering clinical reasoning and interprofessional collaboration, and ultimately improving patient care?

Clinical reasoning in health professions

Impact on patient care

Clinical reasoning is a complex yet essential competence for all healthcare professionals, forming the foundation of accurate clinical decision-making (CDM) in the evaluation and management of patients' medical problems.[1,2] It represents the core thinking process that drives CDM, involving a nonlinear series of cognitive processes.[2] These cognitive processes are mental activities through

which healthcare professionals gather, interpret, and apply knowledge, enabling them to make sound clinical decisions.[2] These decisions are critical for optimizing patient care, which has become increasingly complex due to healthcare trends such as aging populations, multimorbidity, and the expanding range of treatment options. Specifically, therapeutic decision-making has become more intricate, with increasing challenges in managing pharmacotherapy and addressing the prevalence of polypharmacy. The first step toward optimal care is making a correct diagnosis; however, wrong, missed or delayed diagnoses occur in approximately 5% of adult outpatient population annually in the United States.[3] Even when diagnoses are accurate, up to 45% of patients with acute or chronic medical conditions do not receive recommended evidence-based care, including treatment and follow-up.[4] Diagnostic and management errors, including medication-related errors, can lead to patient harm, reduced quality of life, and increased healthcare costs, with a notable proportion being preventable.[5-11] For instance, a systematic review by El Morabet et al. reported medication-related hospital readmissions ranging from 3% to 64% (median 21%, interquartile range (IQR) 14–23%) with preventability rates varying between 5% to 87% (median 69%, IQR 19–84%).[8] Improving the use and quality of guidelines alone, however, seems insufficient to reduce management errors; therapeutic decision-making extends beyond merely following guidelines.[12] It requires clinical reasoning to account for specific patient characteristics, such as comorbidities and co-medication, disease severity, drug properties, clinical context, and patient preferences, in order to determine the most appropriate treatment.[12] The extent to which errors stem from erroneous clinical reasoning, as opposed to external environmental factors, remains unclear. However, multiple studies indicate that reasoning errors, alongside deficits in knowledge and technical skills, play a significant role.[13-16] Many errors are associated with the inherent challenges of human thinking under conditions of complexity, uncertainty, and time pressure.[13,17] Enhancing clinicians' clinical reasoning competence may reduce preventable patient harm, underscoring the need for a deeper understanding of clinical reasoning and its application in practice. Additionally, individual performance is influenced by collective contexts and interpersonal skills.[18] Research identifies inadequate intra- or interprofessional communication and teamwork as frequent contributory factors to medication-related errors.[19,20] Healthcare professionals have been reported to work alongside one another rather than collaboratively, which limits communication about medication.[21] Thinking along with other professions and understanding their clinical reasoning perspectives can improve the ability to distinguish main from side issues, anticipate the information needs of others, lower consultation thresholds, and facilitate joint problem-solving.[22] This highlights the importance of fostering

healthcare professionals' competencies in both clinical reasoning and IPC to reduce preventable harm and improve patient outcomes.

Clinical reasoning as a concept

Research on clinical reasoning has increased significantly over the last five decades, particularly in medicine and nursing.[1,2,23-25] However, a unified understanding of the concept remains elusive–even within these professions.[26,27] It is important to distinguish between a *definition* and a *concept*: a definition implies a full, agreed-upon understanding of a term, whereas a concept is broader and more abstract, encompassing multiple perspectives and interpretations. Given the complexity, context-dependence, and evolving nature of clinical reasoning, it may be more appropriate to view it as a concept rather than something that can be strictly defined.[1,28] Two examples illustrate its evolving nature. First, as demographic and contextual factors increasingly influence clinical decisions–often shaped by healthcare team dynamics, patient preferences, and the broader healthcare environment–the conceptualizations of clinical reasoning have evolved to encompass not only internal cognitive activities but also social and contextual elements.[25,29,30] In this context, *shared decision-making* has emerged as a critical component, integrating the expertise of various health professionals with the preferences of patients to deliver patient-centered care.[31] Second, as healthcare practice has become more team-based, the concept of clinical reasoning is shifting from a predominantly individual cognitive process to a shared, interprofessional activity.[25,30] Engaging with other professions and understanding their reasoning perspectives fosters this shift, facilitating collaborative decision-making.[27] This interprofessional approach is reshaping how clinical reasoning is conceptualized, practiced, and taught across healthcare settings.

In addition to its conceptual ambiguity, the term *clinical reasoning* is often used interchangeably with other terms, such as problem-solving, critical thinking, clinical judgment, and decision-making.[32] While problem-solving and critical thinking are considered general skills relevant across various professions, clinical reasoning typically applies to specific healthcare situations. Both critical thinking and clinical reasoning are context-, setting-, and knowledge-dependent, requiring metacognitive skills.[33] However, clinical reasoning builds upon critical thinking by emphasizing the integration of biomedical knowledge, clinical evidence, prior experience, and collaboration with others, making it unique to healthcare professionals.[33] Clinical judgment and decision-making, in turn, can be viewed as the observable actions and outcomes of clinical reasoning.[2]

The literature often identifies four distinct types of clinical reasoning in clinical practice: *diagnostic reasoning* (What is the matter with my patient?), *etiological reasoning* (How did this problem arise?), *prognostic reasoning* (What will be the course of this problem and what can we achieve?), and *therapeutic* or *management reasoning* (What can we do about it?).[34] In drug-related scenarios, *pharmacokinetic and -dynamic reasoning* may also be used, focusing on understanding pharmacokinetic parameters in relation to pharmacodynamics to explain drug disposition and effects.[35] Research, education, and communication about clinical reasoning are complicated by the numerous terms and varied conceptualizations in use.[25,29,36] Other health professions, such as physiotherapists and osteopaths, also encounter challenges in achieving conceptual clarity around clinical reasoning.[28,30,37] In pharmacy, the conceptualization of clinical reasoning has remained largely unexplored, which forms a key focus of this thesis.

Clinical reasoning in pharmacy practice

Clinical reasoning is a relatively new concept in the field of pharmacy. Over the past few decades, the role of pharmacists has evolved significantly, making clinical reasoning an essential aspect of modern pharmacy practice. Traditionally, pharmacists are responsible for tasks like compounding and dispensing medication, stock management, and quality assurance. With the growing significance of manufacturer-produced medicines with strong pharmacological effects and potential risks, clinical risk management (e.g. dosage control, drug-drug and drug-disease interaction checks) became an increasingly important responsibility of pharmacists. Nowadays, their role extends to providing clinical services in both primary and secondary care settings.[38] These services, which involve direct or indirect patient interaction, include managing minor ailments, conducting comprehensive medication management or clinical medication reviews, and–in some countries–engaging in independent medication prescribing.[39-42] Cipolle et al.[43] defined these services as *Cognitive Pharmaceutical Services*, which involve "the use of specialized knowledge by the pharmacist for the patient or healthcare professionals for the purpose of promoting effective and safe drug therapy." As the scope of pharmacists' roles continues to expand, the number and variety of clinical services are expected to increase. Despite this shift towards more clinical responsibilities, the traditional task of dispensing medication remains central to pharmacy practice.[44,45] Cipolle's definition suggests that clinical services go beyond merely dispensing and even clinical risk management.[45] However, even tasks like dispensing require–besides technical skills–pharmacists to engage in cognitive processes to gather, interpret, and apply information to ensure the safe and effective use of medication.[44] All clinical services in pharmacy practice, including dispensing medication, require

effective clinical reasoning to meet patients' medication needs and improve their overall quality of life. While pharmacists are taking on more autonomous roles, clinical practice is simultaneously becoming increasingly interprofessional. This shift requires pharmacists to adapt their clinical reasoning to not only address individual patient needs but also align with the activities and dynamics with other healthcare professionals, such as general practitioners, medical specialists, and nurse practitioners.[2] Despite these changes, clinical reasoning by pharmacists remains underexplored. The comparisons and distinctions between pharmacists' clinical reasoning and that of other healthcare professionals are unclear, as much of what we know about pharmacists' clinical reasoning is based on studies from other health disciplines.[44] To address this gap, developing a clear concept of clinical reasoning by pharmacists–supported by an understanding of its underlying cognitive processes–would strengthen pharmacy education and empower pharmacists to effectively provide clinical services in practice.

Learning and teaching clinical reasoning

Learning clinical reasoning

Learning clinical reasoning is considered an imperative component of education across health professions. In the Netherlands, this competence is embedded in accreditation standards for educational programs in professions such as medicine, nursing, physiotherapy, and pharmacy.[46-49] To embed competence development effectively in educational programs, it is important to understand and foster the underlying cognitive processes.[50] A widely accepted framework for this is Kahneman's theory,[51] which distinguishes between two cognitive modes or approaches: *intuitive reasoning* (System 1 thinking) and *analytical reasoning* (System 2 thinking). Intuitive reasoning is fast and relies on pattern recognition, whereas analytical reasoning is slower and systematic, involving hypothesis generation or testing.[51] Literature states that novices tend to rely more on analytical reasoning due to their limited experience, working through problems step by step.[2] With continued exposure and practice, they can develop the ability to recognize patterns, transitioning to faster, more intuitive reasoning.[52] Expert clinicians are said to predominantly rely on intuitive reasoning, switching to analytical approaches when encountering complex or unfamiliar cases.[52,53] Clinical reasoning development begins early in medical education, where students focus on building a foundation of extensive biomedical knowledge, gradually forming a semantic network of interconnected concepts.[2] This foundational phase demands substantial time and effort, particularly in integrating knowledge across domains such as (patho)physiology, microbiology, biochemistry, and pharmacology.[2] As this phase progresses, students begin *knowledge encapsulation*, a process that organizes

clusters of knowledge and facilitates automatic reasoning between concepts.[54] They then transition to developing structured knowledge in long term memory known as *illness scripts*. These scripts consist of three components: (i) the patient and contextual factors, (ii) the pathophysiological process, and (ii) the signs and symptoms of a disease.[2,55] With experience, students can refine and enrich these scripts, enabling faster, less effortful reasoning.[56] Building on illness scripts, therapy scripts can emerge to guide treatment decisions.[53] Therapy scripts consists of six components: (i) the problem to be solved, (ii) management options, (iii) preferences, values, and constraints, (iv) education needs, (v) interpersonal interactions, and (vi) encounter flow.[57] However, the use of these therapy scripts and the approaches employed in therapeutic reasoning are underexplored. As students prepare for real-world practice, *contextual learning* becomes essential, allowing them to apply theoretical knowledge in authentic, complex situations. With the shift towards more practice-based education, students can engage in supervised real-world experiences, a process known as *experiential learning*.[58] These experiences expose them to realistic uncertainties and foster *perceptual learning*, helping them develop that "gut feeling".[2,59-61] Particularly in practice settings, *self-regulated learning* is important in developing clinical reasoning by setting objectives, seeking feedback, and reflecting on their experiences.[62,63] As students progress in their education, interprofessional education (IPE) becomes increasingly important, enabling students to understand and appreciate the clinical reasoning approaches of other healthcare professionals.[22,64] IPE involves two or more health professions learning with, from, and about each other, fostering collaboration to enhance decision-making skills and broaden perspectives on patient care.[18] Additionally, grounded in contact theory, IPE brings individuals from diverse backgrounds together, which can modify stereotypes and attitudes toward ingroups and outgroups, ultimately strengthening IPC.[65] As students transition from novice to more expert, the role of the educator shifts from that of a lecturer to a facilitator of learning, allowing them to construct meaning from their own experiences.[25] This learner-centered approach promotes the development of clinical reasoning in real-world settings, helping them become more effective in making clinical decisions that benefit their patients.

Clinical reasoning in pharmacy education

The importance of clinical reasoning is widely emphasized in competence standards for pharmacy educational programs in countries such as the United States,[66] the United Kingdom,[67] New Zealand,[68] and the Netherlands.[46] There appears to be broad consensus of its importance among accreditation bodies, pharmacy educators, and other stakeholders. However, a recent review by Elvén et al. on clinical reasoning curricula across health professions' education found no literature specific to

pharmacy curricula.[50] While a few educational models for clinical reasoning have been described,[69-71] no definitive best practices currently exist for teaching or assessing clinical reasoning in pharmacy education.[33] Although standards of practice documents, such as the Pharmacists' Patient Care Process described by the Joint Commission of Pharmacy Practitioners,[72] often outline valuable action-oriented steps for providing clinical services, they were not designed to foster CDM in pharmacists and pharmacy students. In the Netherlands, pharmacy education comprises a six-year academic curriculum, including a three-year bachelor's degree and three-year master's degree in pharmacy, which is unique in Europe.[73] The bachelor's curriculum establishes a strong foundation in pharmaceutical and natural sciences, with content-driven courses preparing students for the master's curriculum.[46] Among the three Dutch master's curricula in pharmacy, two integrate experiential learning alongside problem-based courses, while the third offers problem-based courses followed by internships afterwards.[73] Although all master's curricula address clinical reasoning, their approaches vary and lack a consistent, evidence-based model. Postgraduate pharmacy education in the Netherlands encompasses continuing education courses and specialized training programs. These practice-based programs include a two-year training in community pharmacy, a four-year training in hospital pharmacy, and a recently developed two-year specialization program for experienced community pharmacists in geriatrics, cardiovascular disease, and other fields.[74-76] While these programs address clinical reasoning, none currently utilize a validated model to enhance this competence. This highlights the need for structured, evidence-based approaches to teaching clinical reasoning at all levels of pharmacy education. Furthermore, pharmacists require enough insight into other healthcare professionals' reasoning to identify potential conflicts or synergies between treatment approaches.[2] To foster this interprofessional mindset, IPE initiatives have been introduced in Dutch educational programs. However, effectively integrating these initiatives are considered challenging, and their impact has yet to be studied.

Challenges in learning and teaching clinical reasoning

The scarcity of clinical reasoning being explicitly and comprehensively taught in health professions curricula may result from its inherent complexity, multidimensionality, and the lack of consensus on its conceptualization across and within healthcare professions. [32,50,77-79] Without explicit teaching, clinical reasoning risks becoming a "black box" phenomenon that students are left to navigate on their own.[77,80] However, teaching clinical reasoning poses multiple challenges. One major issue is the lack of practical guidelines and effective teaching strategies to enhance this competence.[81] Educators in both academic and clinical settings are often not

specifically trained to teach or guide clinical reasoning.[81] Additionally, educators may find it difficult to articulate their advanced reasoning, making it harder for novices to grasp the underlying thought processes.[82] This disconnect highlights the need for structured guidance, supported by practical resources and training, to better equip educators in both academic and clinical settings. Assessing clinical reasoning also poses difficulties, as current methods often prioritize foundational knowledge recall and the "right" answer over evaluating the reasoning process itself.[81,82] While foundational knowledge remains essential, this approach risks overlooking the context-dependent nature of clinical reasoning, where different situations may lead to equally valid outcomes. This underscores the importance of focusing on the reasoning process, in addition to the foundational knowledge. Further barriers to implement clinical reasoning in a curriculum include challenges related to infrastructure, motivation, and culture.[81] For example, lack of a supportive "error culture" and resistance to change can hinder efforts to innovate and improve clinical reasoning education.[81] Furthermore, a challenge lies in teaching students to reason independently within their own professions while also preparing them for IPC. While working with peers from other healthcare professions during IPE shows promise, effectively integrating it remains challenging at micro (teaching, e.g. faculty development), meso (institutional, e.g. administrative processes), and macro (systemic, e.g. social and cultural values) levels.[83]

Research paradigms

Given the predominantly qualitative nature of this thesis, it is important to clarify the research paradigms through which knowledge and reality are approached. This thesis adopts constructivist and post-positivist paradigms to explore CDM and educational experiences in pharmacy. Traditionally, pharmacy research has been grounded in positivism, where knowledge is validated through statistical significance, and reality is viewed as objective and measurable. This paradigm remains invaluable in areas like drug trials and pharmacoeconomics. However, the complexity of CDM and the nuanced impact of educational interventions necessitate alternative perspectives. The constructivist paradigm emphasizes that knowledge is co-constructed through interactions between researchers and participants, shaped by context, time, place, and experience.[84,85] This perspective is particularly relevant for examining the cognitive processes underlying pharmacists' CDM and the factors influencing this process. Similarly, educational experiences are shaped by dynamic interactions between students, educators, and the learning environment. By embracing this paradigm, we acknowledge the inherent subjectivity in interpreting findings, as knowledge is mediated through the perspectives of both researchers and participants. Post-positivism complements this paradigm

by recognizing the existence of an external reality, while acknowledging that our understanding of it is fallible and shaped by biases.[84,85] To explore how educational interventions influence CDM and IPC, we use a combination of qualitative and quantitative methods. While quantitative data reveal patterns and correlations, they are interpreted within the broader, subjective context provided by qualitative insights. By embracing both constructivist and post-positivist paradigms, this thesis seeks to offer a more comprehensive understanding of CDM and educational experiences designed to foster CDM and IPC.

Thesis aim

The aim of this thesis is to explore and understand the concept of clinical reasoning by pharmacists–an essential competence for effective CDM–and to explore the cognitive processes and factors influencing pharmacists' CDM in patient care. Additionally, it focuses on developing and evaluating educational interventions aimed at fostering CDM and IPC, ultimately improving patient care.

Chapter outline

Chapter 2 presents a scoping review with primary studies on the cognitive processes involved in clinical reasoning by pharmacists and their conceptualization. **Chapter 3** provides a detailed exploration of the cognitive processes underlying CDM among Dutch pharmacists across primary, secondary, and tertiary care settings. **Chapter 4** explores the factors influencing their CDM in patient care.

Chapter 5, 6, and 7 focus on the designed (post)academic educational interventions to foster CDM and IPC. **Chapter 5** includes the model to support CDM along with a teaching and learning guide in Dutch. **Chapter 6** explores undergraduates and postgraduates' perceptions of how the model supports their CDM when addressing patient cases. **Chapter 7** evaluates the IPE Pharmacotherapy program involving medical and pharmacy students. Finally, **Chapter 8** provides a reflection on the key findings and discusses their implications for pharmacy practice and (post)academic education, along with recommendations for future research.

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