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

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Chapter 2

Clinical reasoning by pharmacists: a scoping review

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Abstract

Background

Clinical reasoning is considered a core competency for pharmacists, but there is a lack of conceptual clarity that complicates teaching and assessment. This scoping review was conducted to identify, map and examine evidence on used cognitive processes and their conceptualization of clinical reasoning by pharmacists.

Methods

In March 2021, seven databases were searched for relevant primary research studies. Included were studies that examined cognitive processes in pharmacists while addressing a clinical scenario in a pharmacy-related setting. Using descriptive analysis, study characteristics, conceptualizations, operationalizations and key study findings were mapped, summarized and examined. Results were reported using PRISMA-ScR.

Results

From 2252 abstracts, 13 studies were included that examined clinical reasoning in the context of forming a diagnosis (n=9) or determining medication appropriateness (n=4). Most studies conceptualized clinical reasoning as a context-dependent cognitive process whereby pharmacists apply and integrate knowledge and clinical experience to interpret available clinical data. Different terms labelled pharmacists' reasoning that showed both analytical and intuitive approaches to clinical scenarios, either separately or combined as dual process. Medication review studies reported a predominance of analytical reasoning. The majority of diagnosis-forming studies in primary care identified no distinct cognitive reasoning pattern when addressing selfcare scenarios.

Implications

This overview reflects a small but growing body of research on clinical reasoning by pharmacists. It is recommended that this competence be taught by explicating and reflecting on clinical reasoning as separate stage of the clinical decision-making process with transparent cognitive processes.

Background

Clinical reasoning is considered a core competency for health professionals, including pharmacists.[1-4] Clinical reasoning is relatively new to pharmacists when compared to physicians, as the pharmacy profession evolved into a more clinical profession during the past decades by providing more clinical services. Clinical pharmacy services are those that involve direct or indirect patient observation. Pharmacists now provide a wide range of clinical services in each country, including minor ailments management, comprehensive medication management, and independent medication prescribing.[5] The number and variety of services available are expected to increase in the coming years.[6-10] As a result, pharmacists' roles will shift even more from compounding and distributing medication towards providing clinical services. These services require effective clinical reasoning in order to address patients' medication needs and improve their quality of life.[11] For example, when using the Pharmacists' Patient Care Process in clinical services, clinical reasoning is valued throughout the five sequential steps (i.e. Collect, Assess, Plan, Implement, and Follow up).[1,12] Thus, clinical reasoning in pharmacy practice and clinical reasoning education have become essential.[13] Despite its acknowledged importance, an unified understanding of clinical reasoning by pharmacists is lacking.

The literature on clinical reasoning is broad and diverse, with roots in the work by Newell,[14] Elstein,[15] Barrows,[16] and, more recently, Croskerry.[17] The two cornerstone approaches to clinical reasoning described in the literature are intuitive reasoning (or System 1) and analytical reasoning (or System 2).[15] Intuitive reasoning is fast and effortless as it engages automatically, with health professionals acting on intuition or recognized patterns.[17] In contrast, analytical reasoning is slower and requires more mental effort as it involves deliberate, systematic thinking.[17] The most extensively described analytical approaches in medical education and practice are forward reasoning and hypothetico-deductive reasoning.[18-20] The former is a cognitive process whereby data is analyzed to generate an hypothesis, whereas the latter starts with a hypothesis and involves the use or analysis of data to test deductively whether the hypothesis is correct or incorrect.[18-20] Approaching each case analytically is inefficient given the limited time per patient and the health professional's maximum cognitive capacity.[1] Fortunately, repeated analytical processing can eventually lead to a faster intuitive response demanding less mental effort.[17] However, relying on intuitive reasoning is more vulnerable to error.[17] Novice physicians and medical students tend to approach cases more analytically, until they gain enough experience and expertise to work more intuitively.[1] According to available research among physicians, with increasing experience and expertise, physicians can mentally shift from basic science to representations and structures

of knowledge, frequently referred to as illness and therapy scripts.[21,22] Expert physicians tend to rely on intuitive reasoning and use an analytical approach with more complicated and unfamiliar cases.[1,21] According to recent research, the two fundamental approaches are not always conducted as two dichotomous systems.[23,24] The dual process theory states that the two approaches can be conducted jointly to address clinical problems.[23,24] Notwithstanding the broad and substantive literature on clinical reasoning, it is primarily based on research among physicians, leaving limited understanding of used cognitive processes by pharmacists. Despite the extensive research in the field of medicine, little consensus exists on the definition of clinical reasoning by physicians.[25] Other health professions also struggle to conceptualize clinical reasoning, such as physiotherapists and osteopaths.[26,27] Heterogeneous and ambiguous terminology is stated to hinder conceptual clarity.[25,28] Recently, Young et al.[28] identified 110 terms in the literature of various health professions that refer to or are related to clinical reasoning, such as "clinical decision-making", "problem-solving" and "critical thinking". Heterogeneous and ambiguous use of terms in education may result in significant differences in how students and teachers collectively comprehend clinical reasoning, resulting in differences in the focus of teaching and assessment.[29] A clear concept of clinical reasoning within pharmacy, supported by transparent cognitive processes, will contribute to the few existing models and future teaching strategies in pharmacy education.[30-34] Furthermore, conceptual clarity of clinical reasoning within a healthcare profession could also contribute to interprofessional education and collaboration.[35] This scoping review was conducted to identify, map and examine the evidence on used cognitive processes and their conceptualization of clinical reasoning by pharmacists in order to improve conceptual clarity within pharmacy.

Methods

The scoping review method was chosen as the study objective involves exploring the extent of literature, mapping and summarizing the evidence and clarifying a key concept.[36] A study protocol to conduct this scoping review was developed by the assembled multidisciplinary research team with expertise in medical education and specific expertise in pharmacy practice (JM, MB, VD), medical practice (TvG) and qualitative research methods (EK). The scoping review was conducted in congruence with the Preferred Reporting Items for Systematic reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR).[37]

Search strategy

Two team members (JM, EK) independently selected 45 potentially relevant terms from a list of 110 terms related to clinical reasoning categorized by Young et al.,[28] such as "critical thinking", "clinical judgement" and "problem-solving". Terms such as "surgical decision-making" and "accuracy" were excluded from the search strategy because they were thought to provide non-relevant search results to the study objective, When it was likely that relevant search results would be found with a single term, the redundant term was removed. For example, the term "diagnostic reasoning" was included in the search strategy, but the term "diagnosis" was not. Disagreements were resolved through consultation of a third team member (TvG). An experienced medical information specialist compiled the full search strategy based on these terms, which was then further refined by the research team. On March 18, 2012, the search was conducted using the following electronic databases: MEDLINE (PubMed), Embase (OVID), Emcare (OVID), ERIC (OVID), Web of Science, COCHCRANE Library, and Academic Search Premier (EBSCOhost). Appendix 1 contains selected terms and details of the search strategy used for MEDLINE (PubMed) database. In addition, the reference and cross-reference lists of the included articles were screened for relevant articles.

Inclusion and exclusion criteria

In order to summarize and examine what has been studied on the used cognitive processes in clinical reasoning (or surrogate term), only primary studies were included. Other article types (such as reviews) and studied concepts (such as moral reasoning) were excluded. Included studies had to involve pharmacists and/or pharmacy students as the population, and they had to address a simulated or real-life clinical scenario in a pharmacy-related setting. Studies that were included had to explore used cognitive processes during clinical reasoning; otherwise, studies were excluded. Studies that conducted clinical reasoning assessment methods without further exploration of used cognitive processes, for example, were excluded. Only full-text studies, published in peer-reviewed journals and in English were considered for inclusion. As search results were expected to be limited, no publication cut-off date was set.

Study selection

Following the search, all identified articles were collated and imported into EndNote X9 (Clarivate Analytics, PA, USA), with duplicates removed. To assess eligibility of the study selection, a random sample of 25 titles and abstracts was screened by three members of the research team independently (inclusion, exclusion, unsure). Discrepancies and uncertainties were resolved through discussion, and inclusion and exclusion criteria were modified. A second randomly selected sample was screened

in order to reach consensus on more than 75% as established for respecting eligibility for inclusion.[36] For 90% of the sample, consensus was reached. The remaining uncertainties (10%) were resolved through discussion. Thereafter, the same reviewer (JM) screened all identified articles for full text retrieval. The full text of selected studies were assessed in detail against the inclusion criteria. A second reviewer (EK) was consulted when there was uncertainty at any stage of the selection process. A PRISMA-ScR flow diagram is used to report search results (Figure 1).

Data extraction

The following data were extracted in an Excel spread sheet: study characteristics and operationalization (year, first author, study objective, study design, participants, settings and case scenarios), conceptualization of clinical reasoning (terminology, definition, underpinning theoretic and/or conceptual framework), and study findings deemed relevant to the review questions (process steps, cognitive processes, other results and interpretation of results). Two team members (JM, EK) extracted data of three key studies for the draft version of the data extraction spread sheet.[38-40] Any disagreements between JM and EK were resolved through discussion. The other team members were involved in the discussion as needed. The first author (JM) charted the data from the remaining studies, and the results were reviewed by the second author (EK). As a result of this iterative process, the data extraction sheet was regularly modified.

Data analysis

First, study characteristics were described. Extracted data on conceptualization and operationalization were summarized and descriptively analyzed to report how the included studies approached clinical reasoning. Key study findings on used cognitive processes were also summarized and descriptively analyzed. As a scoping review, study quality was not formally assessed.[36] The findings were discussed in the light of relevant clinical reasoning theories, as well as how the findings helped to improve conceptual clarity in pharmacy.

Results

Study inclusion

After removing duplicates, the search strategy yielded a total of 2252 articles. Reference lists and cross-reference screening yielded five additional studies, including recent studies not yet included in the databases searched. Following the inclusion and exclusion criteria, 34 full text articles were assessed on eligibility, with 13 being included for analysis (see Figure 1).

Characteristics of included studies

All included studies (n=13) examined the cognitive processes that occur during clinical reasoning among pharmacists in practice, not pharmacy students. All studies were published after 2008 with an upward trend in the number of publications over time. Studies were predominantly conducted in primary care (n=11).[38,39,41-49] Only the pharmacists studied by Abuzour et al.[50] were licensed to prescribe independently. The majority of the studies (n=6) were conducted in the United Kingdom, with five studies associated to the same research group.[41,42,44,48,49]

Conceptualization, operationalization and cognitive processes

Table 1 summarizes conceptualization, operationalization and key study findings on cognitive processes during clinical reasoning by pharmacists as reported by the selected studies.

Conceptualization

Two main categories of study contexts emerged: diagnosis-forming and medication review. The first category of studies examined clinical reasoning by pharmacists when forming a diagnosis (n=9), whereby pharmacists identify a disease or condition based on its signs and symptoms, such as during referral and triage in community pharmacies, detecting adverse drug events, or when providing specialty care.[40-45,48-50] Diagnosis-forming was followed by treatment planning when pharmacists were licensed to prescribe (n=1) and in selfcare (n=5).[41,42,45,48-50] The second category of studies examined pharmacists' cognitive processes when reviewing medication after diagnosis had been made and treatment had been planned by a physician (n=4).[38,39,46,47] Three of these studies examined community pharmacists determining medication appropriateness after receiving prescriptions in order to dispense medicines, which included checking for appropriate indication, effectiveness, safety, and adherence.[38,39,46] The remaining medication review study examined clinical pharmacists who provide comprehensive medication management services in order to optimize therapy.[40,47]

Terminology as used by included studies is shown in Table 1. In this relatively small selection of studies, the term "clinical reasoning" was used to describe the concept most frequently (n=8).[38,43,44,46-50] Four of these studies used the terms "clinical reasoning" and "clinical decision-making interchangeably".[38,39,44,49] Five studies solely used the term "clinical decision-making".[40-42,45,46] Two studies used the terms "diagnostic reasoning" and "diagnostic decision-making" to describe the concept as well.[43,48]

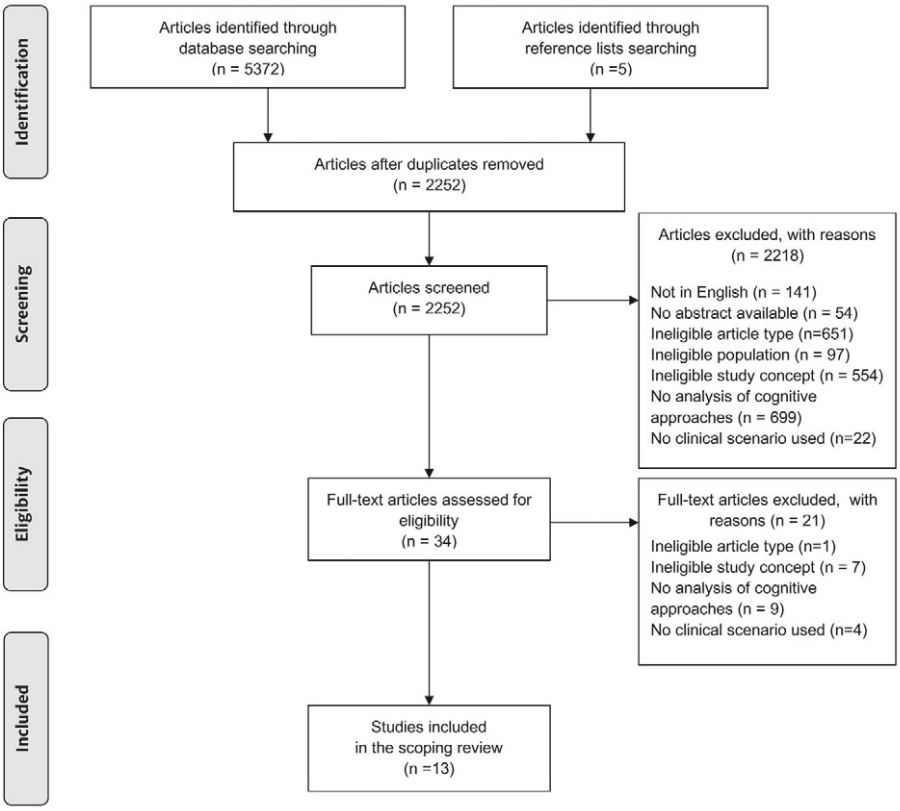

Figure 1. Search results and study selection and inclusion process

Explicitly mentioned conceptual definitions (n=7) revealed similarities and differences (see Table 1).[38,39,43,47-50] When summarizing the similarities, clinical reasoning can be described as a complex cognitive process whereby pharmacists applied and integrated knowledge and clinical experience to interpret all available clinical data. A difference among the definitions provided concerned 'making the decision'. Several studies, including the study of Haider et al.,[43] considered clinical reasoning as a step or stage in the clinical decision-making process (n=3).[43,47,50] This clinical reasoning stage involved the curation of gathered information and the formulation of a feasible set of options. Following stages often included option selection and collaborative planning with the patient or other health professionals. In these studies, the actual decision-making was considered separate from reasoning.[43,47,50] Other studies, such as the study of Croft et al.,[38] integrated decision-making into the clinical reasoning process (n=6).[38,39,41,46,48,49] When not made explicitly, it remained often unclear how the authors viewed clinical reasoning in relation to decision-making (n=4).[40,42,44,45]

All studies, except for Mallinder et al.,[45] mentioned underlying cognitive processes theories that could help in understanding the authors' conceptualization of clinical reasoning and interpreting their reported study findings. Table 1 summarizes the major underlying theories discussed, with several studies explaining intuitive and analytical cognitive processes as single processes (n=7),[40-42,44,46,49,50] while others mentioned the dual process theory solely or additional to intuitive and analytical cognitive processes (n=5).[38,39,43,45,48]

Operationalization

The think-aloud method was most frequently used to study pharmacists' cognitive processes (n=9).[38-41,44-46,48,50] Except for the study of Phansalkar et al., [40] which examined think-alouds during focus groups , participants in all studies were thinking aloud individually. Think-alouds were often followed by semi-structured interviews (n=4).[38,41,45,50] Bhogal et al.[42] and Oliviera et al.[47] conducted semi-structured interviews after observing patient-pharmacist consultations without thinking aloud. Haider et al.[43] conducted surveys to study cognitive processes. Think-aloud data was mostly approached inductively to understand underlying reasoning addressing a clinical scenario (n=6).[39,44-46,48,50] In contrast, Croft et al.[38] used a deductive approach for direct content analysis providing initial coding categories based on the clinical reasoning cycle for nursing practice. The operationalized variables, i.e. cases and study settings, differed between the studies. While the majority of included studies were conducted in primary care (n=11), only Abuzour et al.[50] and Phansalkar et al.[40] were conducted in secondary care and tertiary care, respectively. Several studies observed direct (simulated) pharmacist-patient interaction (n=8).[38,39,41,42,44,46-48] The remaining studies used paper cases (n=5).[40,43,45,49,50] Case content varied across studies and depended on context. Detailed information on used case scenarios and study settings was often lacking.[40,42,44,46-50] Cases were stated to be practice-based in all studies. Pilot tests were frequently conducted for case scenarios.[38,39,41,44,45,48]

Table 1. Conceptualizations, operationalizations and key findings of included studies.

	CONCEPTUALIZATION		
First author (country, year of publication)	**Main term(s) used to describe concept** *Definition, if provided explicitly*	**Context**	**Main underlying theories of cognitive processes mentioned**
Abuzour[50] (United Kingdom, 2018)	Clinical reasoning *Context-dependent way of thinking and decision-making in professional practice to guide practice actions*	Diagnosis-forming and therapy planning	Information Processing Theory (Newell) Hypothetico-deductive approach (Elstein and Schwarz)
Akhtar[41] (United Kingdom, 2015)	Clinical decision-making	Diagnosis-forming and therapy planning	Hypothetico-deductive approach Pattern recognition (Elstein and Schwarz)
Bhogal[42] (United Kingdom, 2013)	Decision-making	Diagnosis-forming and therapy planning	Pattern recognition
Croft[38] (Australia, 2018)	Clinical reasoning Clinical decision-making *Complex process of thinking and decision-making that depends on the ability of humans to process, memorise, recall and synthesize huge amounts of data.*	Medication review and dispensing	Hypothetico-deductive approach Intuitive-humanist model Combination of intuition and analysis (Linn)
Haider[43] (Australia, 2020)	Clinical reasoning Diagnostic reasoning *Cognitive processes involved in reaching a clinical decision*	Diagnosis-forming	Dual process theory
Iqbal[44] (United Kingdom, 2013)	Clinical reasoning Decision-making	Diagnosis-forming	Hypothetico-deductive approach Pattern recognition (Elstein and Schwarz)
Mallinder[45] (New Zealand, 2021)	Clinical decision-making	Diagnosis-forming and therapy planning	Dual process theory (Croskerry) System 1 (pattern recognition) System 2 (analytical)
Nusair[46] (Canada, 2017)	Clinical decision-making	Medication review and dispensing	Intuitive thinking (Croskerry)

OPERATIONALIZATION				KEY FINDINGS
Population (n)	**Summarized methods**	**Case(s)**	**Setting**	**Summarized key findings on used cognitive processes**
Pharmacist and nurse independent prescribers in secondary care (n=10)	Concurrent think-aloud, followed by semi-structured interviews	Three cases per participant in clinical therapeutic areas of choice	Paper cases in private area at participant's work or over the phone	Hypothetico-deductive approach Semantic qualifiers
Community pharmacists (n=10)	Concurrent think-aloud, followed by semi-structured interviews	Case on dyspepsia	Role-played by author at community pharmacy of participant	No distinct cognitive pattern
Community pharmacists (n=5)	Observed consultations, followed by semi-structured interviews	5 real-life consultations	At community pharmacy of participant	Pattern recognition
Community pharmacists (n=10)	Concurrent think-aloud, followed by semi-structured interviews with video-stimulated retrospective think-aloud	Prescription from GP for insulin and antibiotics with risk of ADR	Simulated patient in a simulated community pharmacy	Hypothetico-deductive approach Predictive reasoning Forward reasoning
Pharmacists in primary care (n=29)	Survey	3 case scenarios for absolute CVD risk assessment	Digital	Anchoring bias Framing effect
Community pharmacists (n=4)	Concurrent think-aloud	Case on sub-arachnoid hemorrhage	Role-played by the researcher in unknown setting	No distinct cognitive pattern
Community pharmacists (n=15)	Concurrent think-aloud, followed by semi-structured interviews	Case on bacterial conjunctivitis	Paper case at participant's work	Dual process (pattern recognition and analytical)
Community pharmacists (n=9)	Survey, audio-recorded consultations and concurrent think-aloud	15 real-life think-alouds and 15 real-life consultations	Private consult rooms in community pharmacy of participant	Intuition (refill bias)

Table 1. continued

	CONCEPTUALIZATION		
First author (country, year of publication)	**Main term(s) used to describe concept** *Definition, if provided explicitly*	**Context**	**Main underlying theories of cognitive processes mentioned**
Nusair[39] (Canada, 2019)	Clinical reasoning Clinical decision-making *Cognitive process through which practitioners apply their knowledge and clinical experience in assessing and managing patients' medical problems*	Medication review and dispensing	System 1 or intuitive (automaticity, intuition, pattern recognition) System 2 or analytical (forward-chaining, hypothetico-deductive, if/then) Dual process theory Hindsight reasoning (Hoffman)
Oliviera[47] (Brasil, 2020)	Clinical reasoning *Complex cognitive process that uses formal and informal thinking strategies to gather and analyze patient information, evaluate the importance of this information, and weigh alternative actions*	Medication review	
Phansalkar[40] (Northern America, 2009)	Decision-making	Diagnosis-forming	Hypothetico-deductive approach Pattern recognition Problem-solving by instances or prototypes (Elstein and Schwarz)
Rutter[48] (United Kingdom, 2013)	Clinical reasoning Diagnostic clinical decision-making *Process by which medical practitioners make clinical decisions (and thus a diagnosis)*	Diagnosis-forming and therapy planning	Hypothetico-deductive approach Pattern recognition Combined in the cognitive continuum theory (Offredy)
Sinopoulou[49] (United Kingdom, 2017)	Clinical reasoning Clinical decision-making *A dynamic rather than a static process, in which evidence-based knowledge serves to recognize and interpret clinical data and practical experience allows to integrate all available information into forming a diagnosis.*	Diagnosis-forming and therapy planning	Forward reasoning Problem-solving by instances Pattern recognition (Elstein and Schwarz)

OPERATIONALIZATION				KEY FINDINGS
Population (n)	**Summarized methods**	**Case(s)**	**Setting**	**Summarized key findings on used cognitive processes**
Community pharmacists (n=17)	Concurrent and retrospective think-aloud	Prescription from GP to collect an ARB after an ADR on an ACE-I	Simulated patient in a private consult room in the community pharmacy of participant	(1) Forward-reasoning (2) Hypothetico-deductive approach Also no distinct or multiple cognitive approaches possible In retrospective, dual process Hindsight reasoning
Clinical pharmacists (n=11)	Observed consultations, followed by semi-structured interviews	14 real-life consultations 11 interviews	At primary care, specialty or university clinic or public pharmacy of participant	Hypothetico-deductive approach
Clinical pharmacists in tertiary care (n=5)	Think-aloud during focus groups	Cases on hypo/ hyperkaliemia, somnolence and constipation	Sections of patient records discussed during focus group in hospital	Hypothetico-deductive approach Pattern recognition (prototype matching)
Community pharmacists (n=10)	Concurrent think-aloud	Case on urticaria on the right forearm	Role-played by author at community pharmacy of participant	No distinct cognitive pattern
Community pharmacists (n=8)	Semi-structured interviews	Case on headache	At place of participants' choice	No distinct cognitive pattern

Cognitive processes

Three medication review studies (Croft et al.,[38] Nusair et al.,[39] and Oliviera et al.[47]) reported pharmacists' predominant use of analytical approaches, primarily hypothetico-deductive approach and forward-reasoning.[38,39,47] In the study by Oliviera et al.,[47] for example, study participants used a hypothetico-deductive approach while waiting for serum concentration lab results to confirm or refute their hypothesis to change the pharmacotherapy. Forward-reasoning was used, for instance, by community pharmacists involved in the study by Nusair et al.,[39] to address safety concerns by verifying and collecting data before reaching a conclusion. Intuitive processes were reported less frequently in these studies and mostly in addition to analytical processes (dual process).[38,39,47] Participants in these studies, for example, frequently made assumptions about an unknown indication based on associated medication, pattern recognition, or pharmacology.[39] In another study, Nusair et al.,[46] hypothesized that intuition could explain why pharmacists signed off prescriptions before determining the therapy was indicated, effective, safe, and manageable. Especially when it came to refill prescriptions, pharmacists assumed therapy's efficacy, which could have resulted in premature closure.[46]

The majority of diagnosis-forming studies in primary care identified no distinct cognitive reasoning patterns when addressing selfcare scenarios (n=5).[41,43,44,48,49] Instead, these studies indicated that community pharmacists relied heavily on protocol-led information gathering strategies, particularly the WWHAM-method (Who is it for?; What are the symptoms?; How long have the symptoms been present?; Any other medication being used at the moment?; and what Medication has been tried already?).[41,42,44,48,49] In their study, Akthar et al.[41] reported that pharmacists who used this acronym approach exclusively did not achieve the expected outcome (n=7) compared to pharmacists who relied on matching the patient's signs and symptoms to their previous experience and knowledge (n=3). According to Iqbal et al.,[44] their participants did not embody a clinical reasoning approach because they did not connect any of the information gathered. Biases and knowledge gaps have been reported to contribute to community pharmacists' poor diagnostic reasoning.[41,43,44,48,49] A recent study in New Zealand, on the other hand, identified pattern recognition combined with analytical approaches working through a bacterial conjunctivitis scenario providing the prescription-only medicine chloramphenicol.[45] A small pilot-study in the United Kingdom also identified pattern recognition as cognitive pattern used by community pharmacists working through a dyspepsia case.[42] In secondary care, Abuzour et al.[50] reported that among prescribing pharmacists addressing prescribing scenarios, the use of hypothetico-deductive reasoning combined with semantic qualifiers (adverbs or adjectives)

facilitated access to their illness and therapy scripts. According to Phansalkar et al.,[40] clinical pharmacists in tertiairy care used information from patients' medical records to form hypotheses about possible adverse drug events and validated them (i.e., hypothetico-deductive reasoning). In addition, they reported that pharmacists matched the case data with a mental prototype, necessitating additional information and their ability to make implicit judgments in order to complete the clinical picture beyond the data presented in the case scenario (i.e., pattern recognition).[40]

Despite providing clinical services, four studies reported that community pharmacists' reasoning was frequently technical and product-oriented.[39,41,46,49] According to Nusair et al. [46], when community pharmacists focused more on the patient during medication review, medication was checked for safety rather than indication, effectiveness and adherence. Clinical pharmacists, according to Olivera et al.,[47] approached patients more holistically when providing comprehensive medication management services. In addition to reasoning-related cognitive processes, several studies reported that pharmacists reflected on their own thoughts and actions (n=4).[38,39,41,50]

Implications

The studies included in this review reflect a growing field of research on clinical reasoning by pharmacists, which is consistent with the profession's shift toward a more patient-centered approach. Furthermore, the use of clinical reasoning by pharmacists in various contexts corresponds to the broadening scope of clinical services in pharmacy practice. To effectively teach clinical reasoning–an essential skill for providing these services–it is important to clarify the concept of clinical reasoning by pharmacists.

Conceptualization

In line with most included studies, we conceptualize clinical reasoning as a context-dependent stage of the pharmacists' clinical decision-making process whereby pharmacists apply and integrate knowledge and clinical experience to interpret all available clinical data. This conceptualization is consistent with the clinical decision-making model in pharmacy proposed by Wright et al.[13] Clinical reasoning is used in this model, which focuses on the cognitive processes required for clinical decision-making, to construct patient-centered therapeutic options based on the information gathered in the preceding information gathering stage.[13] The following clinical judgment stage entails weighing-up these therapeutic options and ranking them based on their impact in order to select the preferred option.[13] Afterwards, the decision is made in collaboration with other health professionals and the

patient in the final stage.[13] Although several studies integrated clinical judgment and decision-making in the clinical reasoning process, we recommend that these be separated in the clinical decision-making process in accordance with the model of Wright et al.[13] While keeping the overall process in mind, explicating these cognitive stages separately can contribute to teaching and learning because each stage requires specific skills and can benefit from targeted teaching strategies.[35,51] In addition to Wrights' model, in order to improve clarity in terminology, we recommend putting clinical reasoning into context and purpose of reasoning by distinguishing "diagnostic reasoning" from "therapeutic reasoning" in terms of diagnosis-forming and, therapy planning and medication review. Others, such as Young et al.[29], advocate for being explicit about the intended meaning of the term used. Physicians' reasoning in diagnosis-forming is already often referred to as "diagnostic reasoning" and characterized as the thinking process of 'sorting through a cluster of features presented by a patient and accurately assigning a diagnostic label'.[17,52] In two included studies, the term "diagnostic reasoning" was also used to identify pharmacists' thoughts during diagnosis-forming. The term "therapeutic reasoning" is already often used when physicians think about appropriate patient therapy.[21] Surprisingly, none of the included studies referred to pharmacists' thoughts in therapy planning or medication review as "therapeutic reasoning". The distinction between clinical reasoning subtypes, in our opinion, could contribute in learning and teaching this stage of the clinical decision-making process, as well as interprofessional communication. Moreover, our conceptualization of clinical reasoning in pharmacy can be further enriched by future research, particularly by comparing it to conceptualizations of related health professions. The observed technical and product-oriented focus in pharmacists' reasoning, for example, raises questions on domain specificity, as well as how the patient is involved in this stage of the clinical decision-making process. It also remains unclear how pharmacists handle clinical uncertainties in their reasoning.

Cognitive processes

Both analytical and intuitive cognitive processes were reported by the included studies, either separately or combined as dual process. When determining medication appropriateness, an analytical approach was reported predominantly to an intuitive approach, which is unsurprisingly given their scientific pharmaceutical education.[45] Because intuitive reasoning is more prone to error, pharmacists may have taken a more cautious analytical approach on purpose, as determining medication appropriateness after receiving prescriptions can be viewed as risk management or a safety net for prescribers.[45] It is also possible that the pharmacists' predominant analytical approach was influenced by the complexity of the studied scenario, which

would be similar to expert physicians who use analytical reasoning in complex cases.[45] Whereas physicians tend to rely more on intuitive reasoning with more years of experience, it appears that pharmacists' analytical predominant approach was unrelated, as the participants in the included medication review studies had varying years of experience. However, more research on clinical reasoning development is required. A pharmacist's inability to trust their intuition may also contribute to their analytical preference in medication review studies.[45] Because the cases in these studies were stated to be practice-based and often tested, an analytical preference due to unfamiliarity with the underlying disease or medicines would be less likely. Because there is frequently a lack of case data, a small number of studies and participants per study, and heterogeneity in operationalization, interpreting these results on a dominant analytical approach should be done with caution. Furthermore, because intuitive processes are more difficult to detect using think aloud methods and interviews as operationalization of the concept, underreporting of intuitive approaches in studies is possible.[39] Nonetheless, more patient encounters by pharmacists may enrich therapy scripts, increasing reliance on intuitive reasoning and making processes become more efficient.[21] Reflection on cognitive processes used and awareness of the possibility of bias are recommended to reduce the risk of errors.[53] Because only a few studies reported that pharmacists reflected on their thoughts and actions during the process, encouraging (metacognitive) reflection in pharmacy practice and education is recommended.

Even though several diagnosis-forming studies observed analytical and intuitive processes among pharmacists, the majority of primary care studies identified no distinct cognitive reasoning pattern when community pharmacists relied solely on the WWHAM-method to address selfcare scenarios. Using only this type of mnemonic is in forming a diagnosis is insufficient, because mnemonics are not intended to assist the pharmacist in curating the information gathered in establishing a diagnosis.[54] As mnemonics are still widely used in pharmacy education to address selfcare scenarios,[55] additional teaching strategies to improve diagnostic reasoning are advised. Although these studies were all conducted in the United Kingdom and were related to the same research group, the findings are relevant to this qualitative research, as well as to practice and education in other countries. Improving diagnostic reasoning in selfcare is important given the rise in over-the-counter availability of prescription medicines and it may establish pharmacists' position as the most easily accessible health professional in selfcare even further.

Teaching strategies

Teaching strategies should be developed to help students acquire the necessary knowledge, skills and attitude, which may vary depending on the context of clinical reasoning.[13] More research is needed among pharmacists and pharmacy students to determine what knowledge, skills, attitude and conditions are required. As the closest related health professional, it could be possible to adapt existing medical teaching strategies to help pharmacy students improve their clinical reasoning skills. Tietze, for example, integrated Subjective-Objective-Assessment-Planning (SOAPing) processes with pharmacy-specific elements in her course to guide students in making individual therapeutic recommendations.[33] The recent model of Rutter and Harrison can be used to guide the development of teaching strategies for how to reach a differential diagnosis in pharmacy practice.[54] Their model included the creation of illness scripts to recognize patterns in future patient selfcare encounters. Particularly in the context of diagnosis-forming, adapting medical teaching strategies could be beneficial. More research is needed, however, to determine the effectiveness of teaching strategies adapted from other health professions. Due to the lack of research among pharmacy students, it is unknown whether their cognitive processes differ from those of pharmacists. It is possible that different teaching strategies are required at different stages of education.[56]

Strengths and limitations

A rigorous design was used for this scoping review, which included an established research framework, a comprehensive search method, and a well-documented selection process. Although a broad search was intended, the search method or selection may be insufficient or key sources may be incorrectly excluded. The selection of studies was influenced by choice of terminology in the search strategy and by authors of the studies. Excluding unavailable and non-peer reviewed full-text articles, as well as non-English written articles, may have led to potential bias. However, based on the titles and journals of these articles, missing relevant studies are unlikely. Limiting to primary research among pharmacists or pharmacy students excluded theoretical articles and research among other health professionals. This, however, aided in focusing on studies that examined cognitive processes as they were used by pharmacists in practice, as well as improving our understanding of this concept in this health profession. Future research focusing on comparisons with health professions conceptualizations may enrich our understanding of clinical reasoning by pharmacists. It has to be taken into account that primary studies among pharmacists were grounded on theoretical articles and research conducted among other health professionals, which could have led to cognitive bias. The variety and often missing data of terminology, definitions, operationalized variables, and study

findings associated with clinical reasoning by pharmacists challenged the qualitative data analysis. The heterogeneity in pharmacists' type, level of care, education and roles or tasks in health care settings made data analysis even more difficult as these factors could potentially influence clinical reasoning. Future research should examine how these factors affect clinical reasoning, such as the potential differences between pharmacists working in primary care and pharmacists working in secondary and tertiary care. Because the studies were primarily conducted in primary care, more research is needed to reflect on clinical reasoning across the entire profession. Furthermore, the relatively large number of studies associated to the same research group could have resulted in potential bias. However, because this was a scoping review without a formal quality assessment, all available studies were mapped and summarized, and all available data was used to improve the understanding of the key concept. Furthermore, the knowledge gap on clinical reasoning development was caused by a lack of data on expertise and studies on used cognitive processes involving pharmacy students. Future research involving pharmacy students, novices and experts would improve understanding of clinical reasoning as a dynamic process. No hard conclusions can be drawn due to the heterogeneity, small number of participants, and small selection of studies. Notwithstanding its limitations, these findings improved our understanding of clinical reasoning by pharmacists.

Recommendations for pharmacy education

Based on this scoping review, the following recommendations for pharmacy are made: (1) Explicate each stage of the clinical decision-making process, including clinical reasoning, with transparent cognitive processes; (2) Contextualize clinical reasoning by using the terms "diagnostic reasoning" and "therapeutic reasoning"; (3) Develop teaching strategies to help students and pharmacists improve their diagnostic reasoning when addressing self-care scenarios; (4) Encourage (metacognitive) reflection on clinical decision-making.

This scoping review provided an overview of studies that examined the use of cognitive processes in clinical reasoning in pharmacy practice, whereby pharmacists apply and integrate knowledge and clinical experience to interpret all available clinical data as part of the clinical decision-making process. Pharmacists showed analytical and intuitive approaches during clinical reasoning, either separately or combined as dual process. Using the terms "diagnostic reasoning" and "therapeutic reasoning" to explicate clinical reasoning in diagnosis-forming and, respectively, therapy planning and medication review, could improve conceptual clarity in pharmacy practice, research, and education.

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Conflict of interest

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Appendix 1

Search strategy

Table 1. Selected terms for search strategy

Category	Selected term
Overall	Clinical reasoning
	(Clinical) Decision making
Purpose/goal of reasoning	Diagnostic reasoning
	Clinical problem-solving
	Diagnostic thinking
	Diagnostic decision making
	Treatment decision making
	Therapeutic reasoning
Outcome of reasoning	Choice of treatment
Reasoning performance	Competency
	Clinical competence
	Clinical performance
	Adaptive expertise
	Cognitive expertise
	Expert reasoning
	Expertise
	Medical expertise
Reasoning processes	Hypothetico-deductive reasoning
	Bayesian probabilistic thinking
	Intuition
	Pattern recognition
	Inductive and deductive reasoning
	Analytic reasoning
	Analytical thinking
	Backward forward reasoning
	Backward reasoning
	Cognitive processes
	Critical appraisal
	Higher order thinking
	Intuitive reasoning
	Medical information processing
	Pattern matching
	“Street diagnosis” or in the blink of the eye

Table 1. continued

Category	Selected term
	Metacognition
	Reasoning strategies
	Reflective thinking skills
	Self-monitoring
Reasoning skills	Critical thinking
	Clinical skills
	Cognitive skill
	Critical analysis
	Critical reasoning
	Reasoning
	Reasoning skills
Context of reasoning	Situational judgement
	Situation awareness
	Informed decision making

Table 2. Search strategy conducted on 15th of March 2021 using the search database MEDLINE (PubMed)

Search query	Records retrieved
(("Clinical reasoning"[tiab] OR "Diagnostic reasoning"[tiab] OR "Clinical problem-solving"[tiab] OR "Diagnostic thinking"[tiab] OR "Diagnostic decision making"[tiab] OR "Treatment decision making"[tiab] OR "Therapeutic reasoning"[tiab] OR "Choice of treatment"[tiab] OR "Competency"[tiab] OR "Clinical competence"[tiab] OR "Clinical performance"[tiab] OR "Adaptive expertise"[tiab] OR "Cognitive expertise"[tiab] OR "Expert reasoning"[tiab] OR "Expertise"[tiab] OR "Medical expertise"[tiab] OR "Hypothetico-deductive reasoning"[tiab] OR "Bayesian probabilistic thinking"[tiab] OR "Intuition"[tiab] OR "Pattern recognition"[tiab] OR "Inductive reasoning"[tiab] OR "deductive reasoning"[tiab] OR "Analytic reasoning"[tiab] OR "Analytical thinking"[tiab] OR "Backward forward reasoning"[tiab] OR "Backward reasoning"[tiab] OR "Cognitive processes"[tiab] OR "Cognitive process"[tiab] OR "Critical appraisal"[tiab] OR "Higher order thinking"[tiab] OR "Intuitive reasoning"[tiab] OR "Medical information processing"[tiab] OR "Pattern matching"[tiab] OR "Street diagnosis"[tiab] OR "blink of the eye"[tiab] OR "Metacognition"[tiab] OR "Reasoning strategies"[tiab] OR "Reasoning strategy"[tiab] OR "Reflective thinking skills"[tiab] OR "Reflective thinking skill"[tiab] OR "Self-monitoring"[tiab] OR "Critical thinking"[tiab] OR "Clinical skills"[tiab] OR "Clinical skill"[tiab] OR "Cognitive skills"[tiab] OR "Cognitive skill"[tiab] OR "Critical analysis"[tiab] OR "Critical reasoning"[tiab] OR "Reasoning"[tiab] OR "Reasoning skills"[tiab] OR "Reasoning skill"[tiab] OR "Situational judgement"[tiab] OR "Situation awareness"[tiab] OR "Situational awareness"[tiab] OR "Informed decision making"[tiab] OR "Professional Competence"[majr] OR "Clinical Competence"[majr] OR "Intuition"[majr] OR "Pattern Recognition, Physiological"[majr] OR "Metacognition"[majr] OR (("Thinking"[majr] OR "Clinical Decision Making"[majr]) AND "Professional Role"[majr]) OR "therapeutic decision making"[tiab] OR "decision making"[ti] OR "clinical decision making"[tiab]) AND ("Pharmacists"[Majr] OR "Pharmacists"[ti] OR "Pharmacist"[ti] OR "Pharmacy"[Majr] OR "Pharmacies"[Majr] OR "pharmacy"[ti] OR "pharmacies"[ti]) NOT (("Review"[ptyp] OR "review"[ti] OR "editorial"[pt] OR "comment"[pt] OR "systematic"[sb]) NOT ("Clinical Study"[ptyp] OR "trial"[ti] OR "RCT"[ti])))	1467