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Clinical Reasoning in Physical Therapy: A Concept Analysis

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Background. Physical Therapy, along with most health professions, struggles to describe clinical reasoning, despite it being a vital skill in effective patient care. This lack of a unified conceptualization of clinical reasoning leads to variable and inconsistent teaching, assessment, and research.

Objective. The objective was to conceptualize a broad description of physical therapists' clinical reasoning grounded in the published literature and to unify our understanding for future work related to teaching, assessment, and research.

Design/Methods. The design included a systematic concept analysis using Rodgers' Evolutionary methodology. A concept analysis is a research methodology in which a concept's characteristics and the relationship between features of the concept is clarified.

Results. Based on findings in the literature, clinical reasoning in physical therapy was conceptualized as integrating cognitive, psychomotor, and affective skills. It is contextual in nature and involves both therapist and client perspectives. It is adaptive, iterative, and collaborative with the intended outcome being a biopsychosocial approach to patient/client management.

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Limitations. Although a comprehensive approach was intended, it is possible that the search methods or reduction of the literature was incomplete or key sources were mistakenly excluded.

Conclusions. A description of clinical reasoning in physical therapy was conceptualized**,** as it currently exists in representative literature**.** The intent is for it to contribute to the unification of an understanding of how clinical reasoning has been conceptualized to date by practitioners, academicians, and clinical educators. Substantial work remains to be done to further develop the concept of clinical reasoning for physical therapy, including the role of movement in our reasoning in practice.

Physical therapists are expected to be innovative, collaborative, patient-centered, practitioners.[1] To engage in this high level of practice, therapists must possess the knowledge, skills, behaviors and values to address the naturally ambiguous nature of patient cases within complex and uncertain contexts.[2,3] Physical therapists, along with most other health professionals have been struggling to understand, describe and define how one approaches these ill-structured, varying, complex clinical problems. Clinical reasoning is one term that has been used to refer to the integration of thinking and decision making involved in working through clinical scenarios; other terms used have included medical decision-making, and diagnostic reasoning. For this paper, we will use the term “clinical reasoning”. Despite decades of work attempting to understand clinical reasoning (CR) a “gold standard,” consensus conceptualization or description remains elusive.

[HD2]Current Limited Agreement on Clinical Reasoning

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Academic education programs across the United States do not share an understanding of clinical reasoning, and report highly variable and inconsistent approaches to teaching and assessment within and between programs.[4] This lack of agreement on the concept has negative implications for teaching, assessment, and research related to clinical reasoning. Experts in physical therapist education repeatedly recommended the use of benchmarks to assess performance of clinical reasoning[5] and increased standardization of educational outcomes within the profession.[6] The physical therapy profession would benefit from the development of benchmarks for clinical reasoning across professional education, from entry-level to residency and beyond, however the lack of consensus about how we conceptualize clinical reasoning has limited progress.[5]

A shared understanding can lead to a more unified body of research on clinical reasoning. Research to date has mainly focused on the cognitive factors associated with reasoning.[7,8] More recent research in clinical reasoning across professions has broadened the scope of investigation to include narrative and contextual factors.[9,10] A broader conceptualization of clinical reasoning would facilitate research that explores or identifies other factors that we suspect are related to reasoning characteristics or performance. For example, greater clarity about the concept of clinical reasoning could better elucidate how a profession's lens or perspective influences the way its members enact clinical reasoning in practice. The current literature on expertise in physical therapy points to the influence of the physical therapist's professional lens or focus of their practice. A focus on movement has been highlighted in expert practice within physical therapy[11] yet is not well explored as related to how movement is used in reasoning.

The purpose of this project was to explore the literature to conceptualize a broad description of physical therapists' clinical reasoning and unify our understanding for future work related to teaching, assessment and research.

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[HD2]Concept versus Definition

The complex, contextual, and evolving nature of clinical reasoning limits our ability to define it. A definition is a formal statement of the meaning or significance of a word or phrase whereas a concept is an idea of something formed by mentally combining all its characteristics or particulars.[12] A definition indicates full understanding and consensus of what a word or phrase means, while a concept is broader in scope and cognitive in nature. A concept includes attributes and characteristics expressed in some form and utilized for a common purpose.[13] A concept also allows for exploration of further questions prompted by its analysis; it evolves over time. Given the complexity and limited understanding of clinical reasoning, it may be more appropriate to focus on describing it as a concept rather than something that can be clearly defined.

A concept analysis is a research methodology in which a concept's characteristics and the relationship between features of the concept is clarified.[14] Aristotle described it as attempting to "demonstrate the essence of things."[15] One attempts to categorize characteristics with an understanding that they are not mutually exclusive. A characteristic may be present in one situation and absent in another, but it is still considered a characteristic of the concept. Some characteristics will be more typical than others. The inductive process of concept analysis includes examining related disciplines to describe how the concept being examined may be similar or disparate from how it is conceptualized in related fields. A concept analysis differs from a literature review in that it attempts to characterize or refine a concept whereas a literature review is a knowledge synthesis of what we know thus far. There are several methods of concept analysis. We chose Rodgers' evolutionary view whose premise is that concepts develop over time and are influenced

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by the context in which they are used.[16] The intent of this type of analysis is primarily to indicate a direction for further research and a clearer understanding of the concept but not to provide a definite conclusion or definition.

There are three phases to Rodgers' evolutionary approach.[16] In phase one, the concept to be analyzed is chosen, and the scope of the data collection is identified and conducted. Phase two is the core analysis phase in which identification of the key concepts, attributes, antecedents, and consequences of the literature are established. Phase three is a further analysis phase where the primary intent is to generate questions for future research. These three phases will serve as an organization framework for the manuscript.

[HD1]Phase 1: Concept and Scope of Data Collection

The concept of interest was clinical reasoning in physical therapist practice. The initial step was to determine the scope of the data collection. A librarian using keywords supplied by the researchers, completed an initial search in Scopus, a citation and abstract database of peer-reviewed literature that can be used to determine the impact of specific authors, articles and journals. The search allowed the researchers to use impact, frequency of cited authors, keywords and journal titles to ensure the search was broad enough to be fully inclusive and yet exclude disciplines and articles that did not have sufficient impact or scope. Keywords for the initial search included: clinical reasoning, critical reasoning, critical thinking, diagnostic reasoning, clinical problem-solving or practical reasoning. Twenty-seven disciplines had greater than fifty articles using these keywords. The researchers reviewed the list and removed disciplines unrelated to medicine or healthcare and those that did not involve human interaction. The following disciplines remained: medicine, nursing, pharmacy, psychology, dentistry and health professions (physical therapy, occupational therapy). The librarian completed a second search in Scopus using the same keywords, the identified disciplines and advanced search features that limited results to those published

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in 1990 or later and included top authors in each field identified by the number of publications per author. Arthur Elstein's seminal article[8] that essentially initiated substantial work related to the understanding of clinical reasoning was published in 1990 and therefore determined the cutoff date. The initial search identified 2,037 articles. One researcher read each abstract and removed articles that were not related, for example if the article discussed the clinical reasoning for a specific patient case or a teaching pedagogy. Table 1 provides the initial search results and the results after the initial reading.

Consistent with concept analysis methodology, in addition to the literature search, researchers also included widely recognized and well-established textbooks related to clinical reasoning. Due to our work in this area, we were aware of internationally recognized core texts[17,18] in the field that we wanted to screen for any relevant content not already included via our review of the information identified in the search.

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[HD1]Phase 2: Core Analysis

The core analysis involves identifying key elements including antecedents, consequences, surrogate terms, related concepts and attributes of clinical reasoning across disciplines. Antecedents and consequences are those events that occur before or after the concept being analyzed. Antecedents can be conditions, behaviors or attitudes that occur before clinical reasoning while consequences are the outcomes of clinical reasoning. Surrogate terms are synonyms or interchangeable terms for clinical reasoning whereas related concepts are words that have something in common with the clinical reasoning yet do not possess all of the same characteristics. Attributes are considered qualities or characteristics ascribed to the concept.[19,20] These key elements were then examined through an inductive process to create a linguistic description of clinical reasoning in physical therapy. Four of the authors, all physical therapists with research experience (including qualitative research) related to clinical reasoning and substantial knowledge of the research related to clinical reasoning in other disciplines completed the core analysis. The fifth researcher, also a physical therapist with research experience, did not participate in the core analysis but verified themes derived from the analysis through a member check process.

[HD2]Process of Core Analysis

The core analysis was carried out in six steps, followed by two steps for synthesis (see Fig. 1). Articles identified in the initial search were retrieved. The research team developed a spreadsheet system for data organization. The spreadsheet included columns for the reference, discipline, surrogate terms, related concepts, antecedents, consequences, attributes and other contextual factors. The team completed a trial data extraction, reading 2-3 articles each, and utilized the spreadsheet to explore its functionality. The research team then held a conference call to discuss how each category was conceptualized, ensuring consistency. After this trial, discussion, and

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clarification of how categories were conceptualized, articles were read and data extracted and recorded on the spreadsheet (see Tab. 2 for examples). Using this data, the research team determined the salient themes within each category in each discipline. The salient themes were recorded in a spreadsheet linking each to the relevant references (see Tab. 3). Finally, the salient themes were used to describe how clinical reasoning was conceptualized in each discipline.

Clinical reasoning concept synopses were developed for each profession. The purpose of developing synopses was to facilitate an exploration of similarities and differences between other disciplines and physical therapy. Exploring similarities and differences is an important component of concept analysis as it helps facilitate the exploration of unique identifying features of the concept. The steps in Phase 2 analysis (identifying key elements) provided the framework to develop these summaries. The fundamental characteristics and related concepts were explored to illustrate the focus and breadth of clinical reasoning specific to each profession. The contextually relevant antecedents describe the information sources, knowledge, clinical interaction that initiates the clinical reasoning process. The consequences are the knowledge, skills, and behaviors that are evidenced in effective clinical reasoning within each profession. Description of the attributes provides context allowing for identification of signature elements within each profession. The development of synopses was an inductive process driven by frequently cited themes in each category (listed in Tab. 3) of the initial analysis of the key elements (antecedents, consequences etc). These synopses were completed in an iterative manner: the initial synopsis was developed by one author, then reviewed and critiqued by the other 4, then revised until consensus was achieved.

[HD2]Synopses of Clinical Reasoning by Discipline

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Clinical reasoning of physicians was most often described as physician centric and focused on arriving at a correct diagnosis diagnosis.[2,8,21-60] Related terms included decision- making[56,61-63] and diagnostic reasoning.[2,21-25,49,51,54-56,58-60,64-70] The related concepts and antecedents focused primarily on the internal cognitive processes of physicians such as analytical and non-analytical reasoning,[50,53-55,62,63,71-75] bias,[21,49,54,76-78] and hypothesis testing.[2,8,21,24,36,37,42,79-81] Attributes were also related to knowledge and organization of knowledge.[2,23,50,51,60,62,71-73,82] The role of reflection and deliberate practice were prevalent as well.[54,64,68,70,77,83] There were some noted differences in the Emergency Medicine where diagnosis becomes secondary to maintaining life and preventing catastrophic outcomes.[76]. Osteopathy highlighted the role of movement and "doing" such as performing special tests to inform judgments.[61,81,84] In the more recent medical literature, there was an increasing emphasis on the role of context and patient preferences as part of the reasoning process.[33,44,64,85-87]

In the nursing literature, related terms were critical thinking[88-96] and clinical reasoning. The outcomes of reasoning in nursing focus on competence[97,98] and establishing a nursing plan of care.[93,99,100] Outcomes also focused on the important role of nurses in recognizing changes in signs and symptoms,[101-105] and providing early warning of changes in patient's status. There are strong links between descriptions of clinical reasoning in nursing and the importance of noticing or surveillance,[101,102,106,107] as well as the explicit acknowledgement of intuition as valuable in early detection of status changes.[100] The importance of a connection between clinical thinking and moment-to-moment actions, and patient interactions was also described.[108,109] Nursing literature is replete with information on educational strategies to facilitate reasoning in nursing students.[89,108,110-112]

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Related terms in pharmacy included critical thinking and problem-solving focused on the thinking skills of the pharmacist. The focus of literature was on didactic instructional activities[113,114] and pedagogical approaches[115-118] to meet learning objectives for skill development in critical thinking. Several studies did include development of skills associated with clinical reasoning, such as reflection[119,120] and cognitive flexibility.[121] These skills were not explored in context of clinical practice or clinical reasoning. As evident in Table 3, a process of clinical reasoning was not elucidated in the pharmacy literature. Most of the articles focused on teaching interventions for general critical thinking and therefore did not provide insight into the specific nature of clinical reasoning in pharmacy. Therefore, pharmacy was excluded from later analysis.

Related terms in psychology include clinical decision-making,[122] diagnosis.[123-130] Related concepts and antecedents directed at cues,[122,123,131] key features,[132] hypothesis testing[127-129,133] and statements made or a situation presented.[126,133,134] The consequence was a formed judgement[125,127,135-137] and attributes included critical thinking,[122,134,136,138-143] reflection,[141] weighing information,[132] flexibility in thinking.[142] There is recognition that human reasoning is error prone.[124-129,133,143-145] Many of the psychology articles were primarily discussing medical reasoning related to physician diagnoses and problem solving.[124,125,129,130] Those articles that focused specifically on psychology related clinical reasoning to critical thinking and logical problem solving.[122,138,140,144]

Related terms in the health professions (PT, OT) literature included critical thinking and decision-making.[9,146] Related concepts and antecedents include intuition, knowledge,[146,147] biopsychosocial model,[148,149] patient/client needs.[9,146,149-152] The consequence was patient/client management.[147,149,151-154] Attributes included intuition,[146] patient and therapist perspectives,[9,146-148,150,151,155-161] flexibility in thinking, reflection.[9,148,155,160,162,163] Also included were a dialectical approach[151,153,158,160] and negotiating

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shared meaning.[9,146-148,150,156-161] Four articles in the physical therapy literature alluded to human movement as related to clinical reasoning.[11,159,161,164] While not identified in the initial search, additional articles in the physical therapy literature highlighting expert/novice differences and the developmental nature of therapists' reasoning were deemed informative and thus included.[11,165-168]

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[HD2]Working Description of the Concept of Clinical Reasoning in Physical Therapy

The final stages of the core analysis include identifying patterns in the data (attributes, consequences, etc.) to summarize the major themes in the concept.[20] This stage included developing a model that demonstrates the connections between key elements (attributes, consequences, related terms etc.) and disciplines. The synopses described were used to create a conceptualization of clinical reasoning in physical therapy. Fundamental components based on attributes, antecedents, and consequences consistently present across the disciplines were identified. In the following section the conceptualization of clinical reasoning is described, and the key components are described in more detail.

Based on the concept analysis and the themes and patterns that emerged, clinical reasoning in physical therapy could be conceptualized as integrating cognitive, psychomotor and affective skills. It is contextual in nature and involves both therapist and client perspectives. It is adaptive, iterative and collaborative with the intended outcome being a biopsychosocial approach to patient/client management. The following paragraphs provide greater detail related to specific elements of the conceptualization. The reader is also referred to Table 3 for the specific data sources describing each element.

[HD3]Cognitive

Physical therapists engage in a variety of cognitive skills in effective clinical reasoning. Cognitive skills are necessary to engage in intellectual problem solving.[169] These cognitive skills represent an interaction between working memory (where processing occurs) and long-term memory (where knowledge is stored and organized).[170,171] Many models of long-term memory have been proposed, but the concepts of schema and scripts are most pertinent to clinical reasoning.[171] The roles of scripts for knowledge organization are evident in

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the clinical reasoning of expert clinicians.[47] Higher order cognitive skills, including problem solving and decision-making, are essential for clinical reasoning.[171]

The depth of a practitioner's experience shapes how they organize information throughout the course of arriving at decisions. Hypothetico-deductive reasoning is characterized by generation of a limited number of hypotheses early in the diagnostic process that guide subsequent collection of data, most often focused on diagnostic questions.[2,25,31,158] Each hypothesis can be used to predict what additional findings ought to be present, and the diagnostic process is a guided search for these findings as well as an attempt to rule out other likely hypotheses.[8] Such reasoning processes are observed more commonly in novice practitioners.[166,172,173] As practitioners gain experience they are more likely to use forward reasoning.[11,31,59,165] This type of reasoning is inductive in nature, systematically analyzing data to reach a hypothesis or diagnosis.[174] Forward reasoning is characterized by speed and efficiency and is more likely to occur in familiar cases where therapists recognize patterns in the clinical presentation.[2,146,158]

Reflection and metacognition are important components of clinical reasoning in physical therapist practice.[148] Reflection-in-action is the ongoing metacognitive activity that is occurring during patient-therapist interaction. Conversely, reflection-on-action occurs as an individual looks back on an interaction and results in a broadening of or revised insights into clinical reasoning.[175] Both reflection-in-action and reflection-on-action[147] are observed during clinical reasoning, but used differently with respect to reasoning strategies and/or degree of experience and expertise. Overall, experts use reflection more frequently than novice physical therapists[176] and are more likely to demonstrate reflection-in-action during patient interactions.[166,167]

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The meta-cognitive activity of reflection allows the practitioner to link thoughts and ideas, to integrate new knowledge with existing knowledge, and to expand their own clinical reasoning/decision making framework.[175] Reflection-in-action, for example, may be used to develop or alter an examination or intervention during a patient encounter. Ongoing metacognitive use of reflection will allow continued assessment of activities throughout the patient interaction. Reflection-on-action allows a practitioner to think back on and assess prior activities. This "thinking back" may inform reflection-for-action, or planning for future activities.

Most other disciplines refer to cognitive skills as decision-making and critical thinking. Medicine specifically describes an internal cognitive process (decision making and diagnostic reasoning) to arrive at a diagnosis.[56, 61-63] Psychology similarly used the term cognitive thinking to refer to clinical decision-making as the reasoning process to determine a formed judgment/diagnosis.[122-130] Nursing primarily focused on critical thinking, particularly related to recognizing changes in signs and symptoms that would change a plan of care.[97-105] The ability to critically think was directly related to competencies in nursing practice.[94] Pharmacy discussed critical thinking and problem-solving as their cognitive reasoning process.[113,114,119,121,219]

[HD3]Psychomotor

The role of movement in clinical reasoning appeared in the osteopathic, occupational, and physical therapy literature. The osteopathic literature highlighted the act of "doing" and how physical skills are used to evaluate hypothesis and gather information that informs the practitioners thinking.[84] Physical therapy literature included the role of movement as a source of integrated knowledge and a characteristic of expert practice.[11,164,172] Specifically within the literature reviewed, occupational therapy and physical therapy literature considered the importance of static and dynamic observation of the patient as an antecedent to clinical reasoning.[146,150,151] Teaching and

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learning of movement were included as desired outcomes of clinical reasoning.[152,159] More recently, Oberg et al[161] theorized movement as both enacted and embodied and suggest that both forms are integrated in the decision-making process. Physical therapists rely heavily on their bodies and hands as sensori-motor tools to gather and transmit information used in their clinical reasoning.[161] The development of the role of movement in the clinical reasoning literature appears to lag behind the attention to cognitive and metacognitive processes as far fewer articles address the role of movement. The final section of this paper explores the implications this disparity in the literature.

[HD3]Affective

Under-recognized skills of clinical reasoning in the affective domain are largely due to the inability for physical therapists to objectify the assessment of these skills. Affective skills are essential in effective clinical reasoning process as they add the emotional component, which is vital for learning and processing. Activities that intensify the emotional state enhance both meaning and memory.[177] The professional that engages in clinical reasoning with an elevated emotional state will learn and remember.

Other professionals took affective skills into consideration in clinical reasoning.

The nursing profession looked at emotional intelligence in clinical decision-making. Bulmer & Smith[88] indicated that emotional intelligence impacts the quality of student learning and ultimately patient care and outcomes. Medicine determined that affective bias influences the decision-making process. Both positive and negative emotions in clinicians when interacting with patients may affect the cognitive component of the diagnostic process.[178]

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Psychology, interestingly enough, utilized very few characteristics in the affective domain when defining the reasoning process. They relied heavily on cognitive skills, directly related to critical thinking skills, to make clinical judgments. Pharmacy, too, embraced critical thinking as the primary component of their reasoning process without mention of the affective characteristics that may influence this process. One study indicated that there was a relationship between personality traits and critical thinking test scores[121] but there was minimal mention of emotion or affective skills related to reasoning.

[HD3]Reasoning Strategies (Adaptive, Iterative, and Collaborative)

The cognitive, affective and psychomotor skills discussed previously are frequently combined and used in various reasoning strategies. These reasoning strategies have been well described in the literature[158,179] While it is beyond the scope of this manuscript to describe them all, the reader is encouraged to review Edwards (2004)[158] article that describes eight reasoning strategies: diagnostic, narrative, reasoning about procedure, reasoning about teaching, predictive, interactive, *collaborative* and ethical reasoning.[158] The *collaborative* nature of clinical reasoning is highlighted through multiple references to the importance of involving the patient, family, and other healthcare team members in the reasoning process.[149,158,160,161] Therapists fluidly transition between these reasoning strategies based on patient cues. Use of these varied types of reasoning in response to an unfolding situation is indicative *adaptive* nature of physical therapists' clinical reasoning.[149,158,160] *Iterative* describes the spiraled and cyclical nature of the PT's reasoning integrating synthesis of information, ongoing analysis, reflection, and revisiting ideas in the reasoning process.[148,160-162]

[HD3]Biopsychosocial Approach to Patient Management

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The outcome of clinical reasoning in physical therapy focuses on a biopsychosocial patient-management approach. Patient management is broad term to capture all of the decisions made as a result of the therapist's clinical reasoning. These decisions include the physical therapy diagnosis (an analysis of the relations of the patient's impairments and disability alongside the co-construction of meaning by the patient and PT).[147,149,151,152] Goals that are shared and co-developed by the PT and patient are a crucial aspect of management.[9,146,158] The diagnostic process should lead to an organized approach to treatment that includes education and collaborative work with the patient.[153,154] The PT's work with the patient should also address teaching and learning of movement.[152,159] As noted in the section on psychomotor skills, the outcomes can be impacted by the PT's physical handling skills.[161]

[HD1]Phase 3 - Discussion/Future Work

The purpose of this paper was to explore the literature, attempting to conceptualize a description of physical therapists' clinical reasoning, grounded in the profession's relevant research and theoretical literature. The intent was that the conception of clinical reasoning in physical therapy described here can provide a unified understanding to serve as a foundation for future educational research to guide our work in teaching, learning and assessing clinical reasoning. Exploring reasoning across disciplines helped to highlight the unique professional lens through which physical therapists approach reasoning, and aspects of clinical reasoning in common among multiple health professions. We conceptualized clinical reasoning in physical therapy as i*ntegrating cognitive, psychomotor and affective skills. It is contextual in nature and involves both therapist and client perspectives. It is adaptive, iterative and collaborative with the intended outcome being a biopsychosocial approach to patient/client management.* Consistent with the concept analysis methods employed, the purpose of Phase 2 is not to describe all of factors that inform clinical reasoning. Figure 2 illustrates the current state of clinical reasoning

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derived from the literature. This figure is dynamic, representing the evolving nature of clinical reasoning rather than an endpoint. This conceptualization of clinical reasoning will evolve as subsequent research questions are pursed to expand our insights into clinical reasoning.

The physical therapy profession shares elements of our clinical reasoning approach with other health professions such as medicine and nursing; these include a focus on patient-centered, collaborative reasoning,[11,83] and inclusion of reflective and iterative components.[70,147] These patterns suggest there are broad commonalities seen across clinical reasoning of many of the health professions, and yet each profession's unique practice focus also shapes the differences in their conceptualizations.

We believe the conceptualization proposed highlights the unique emphasis physical therapists place on the use of our bodies and the bodies of our patients as key information gathering and transmission components of clinical reasoning in physical therapists' practice, while also acknowledging the universal role of thinking and feeling, reflecting and patient-centeredness.

As a relatively young profession, physical therapy continues to emerge and define itself and its scope of practice. Perhaps one of the most important aspects of this emergence are the relatively recent attempts to define our focus on movement as the essential defining element of our practice. Despite the relative paucity of published clinical reasoning literature that explicitly describes the relationship between the clinical reasoning of physical therapists and movement, and in keeping with the historical perspective of Rogers' concept analysis methodology,[16] it is worth noting the ways this relationship has been described to date, in order to ground future scholarly discussion and research.

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Embrey & colleagues[164] explicitly described movement scripts as a specialized form of practice-derived knowledge used in clinical reasoning, integrated with a consideration of psychosocial and contextual factors, and iterative self-monitoring (metacognition) by the clinician. Similarly, Wainwright and colleagues[172] included observations of patients' movement behavior and associated problem solving as a source of information integrated into the clinical decision making of both novice and experienced physical therapists. Jensen and colleagues' seminal research describing expertise in physical therapists' practice,[11,165] included a focus on movement as one characteristic of expert practice. A focus on movement was described as interdependent with experts' clinical reasoning, along with virtues and values, and focus on function. Edwards & colleagues[159] explored ways in which both deductive and inductive (narrative) reasoning are necessary to illuminate patients' perceptions of their movement abilities and the relationship of understanding these perceptions to being able to clinically reason about movement with patients with chronic pain. They grounded this scholarly discussion in Edwards et al (2004)[158] and Edwards and Jones (2007)[151] research describing the clinical reasoning of expert physiotherapists.

Most recently, Oberg & colleagues[161] presented an extensive theoretical discussion about clinical reasoning, concluding that in physical therapy, it is both embodied and enacted. Embodied and enacted imply that the body should be conceived as center of experience and expression as well as a physical function. Further, the therapist should respect that the patient lives in his/her body and experiences the world through that body. They described it as an explicit link the fundamental focus in physical therapy on the body and movement, and clinical reasoning. They argue that in adopting a biospychosocial approach to healthcare, one must consider that when reasoning about movement, one is reasoning about the person as embodied, and the way they move in the world. The body and its movement are seen as essential aspects of consciousness and an intrinsic aspect of lived bodily movement and action. An important contribution these authors make to the conceptualization of clinical reasoning in physical therapy is that both the patient and the therapist are embodied and

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use their bodies to perceive aspects of the understanding they co-create about the patient's movement. In other words, these authors argue that clinical reasoning cannot be considered as only an exchange of linguistic/communicative events between the therapist and patient, as described previously by Edwards and colleagues.[159] Movement perceived and enacted by each is a critical aspect of gathering information to develop an understanding of the patient's limitations, and the movement perceptions of both are also required to intervene to facilitate change in the patient's movement abilities. The view of movement as an integrated aspect of the clinical reasoning of physical therapists by Oberg & colleagues[161] is consistent with recent research that denotes the signature pedagogy in excellent physical therapists' education as "the body as teacher."[180]

By establishing a common understanding of the concept of clinical reasoning as we know it to date, this work can contribute to moving the educational community forward towards necessary improvements in the teaching, learning, and practice-based assessment of clinical reasoning development described by Jensen et al.[180]

Further implications of this work can be considered when comparing the concept of clinical reasoning in physical therapy, and, in particular, the embodied and enacted aspects of clinical reasoning and movement with emerging descriptions of The Movement System.[181] It will be important to integrate more current conceptions of clinical reasoning as integrated with perceptions of movement of both the clinician and the patient, including an exploration of a biopsychosocial (not just biophysiological) perspective of movement and the clinical reasoning required to collaboratively resolve movement dysfunctions with our patients.

Finally, when considering the significant amount of focus health professions are placing on development of effective and efficient interprofessional team-based care, it is important to consider the implications for establishing a clear concept of clinical reasoning for

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physical therapists, as well as all other disciplines involved in team-based care. Future research describing clinical reasoning of "the team" as a whole, and how this may differ from the reasoning of non team-based professionals may help provide insights about interprofessional care that are as yet unknown. Also, explorations of what aspects of the clinical reasoning of the health care team are specific contributions from the various members' unique professional reasoning focus, and what aspects are generic among all members of the interprofessional team could be helpful in determining optimal composition of healthcare teams for various clinical contexts.

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[HD1]Limitations

The focus of this article was the concept of clinical reasoning. We included other disciplines as a basis of comparison and to derive any relevant concepts that may have applied to physical therapy. Although a comprehensive approach was intended, it is possible that our search methods or reduction of the literature was incomplete or key sources were mistakenly excluded.

[HD1]Conclusion

Previous work indicated a lack of consensus on how we describe, teach and assess clinical reasoning. To improve the teaching and assessing of clinical reasoning we need a unified understanding of the concept. We have attempted to conceptualize a description of clinical reasoning in physical therapy as it currently exists in representative literature, with the intent that it can be used to unify practitioners, academicians and clinical educator in our understanding of how clinical reasoning has been conceptualized to date. Substantial work remains to further develop the concept of clinical reasoning for physical therapy that includes the role of movement in our reasoning in practice. It is our hope this paper can stimulate fruitful discussion and provide direction for future work related to clinical reasoning.

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Figure 1: Analysis process timeline

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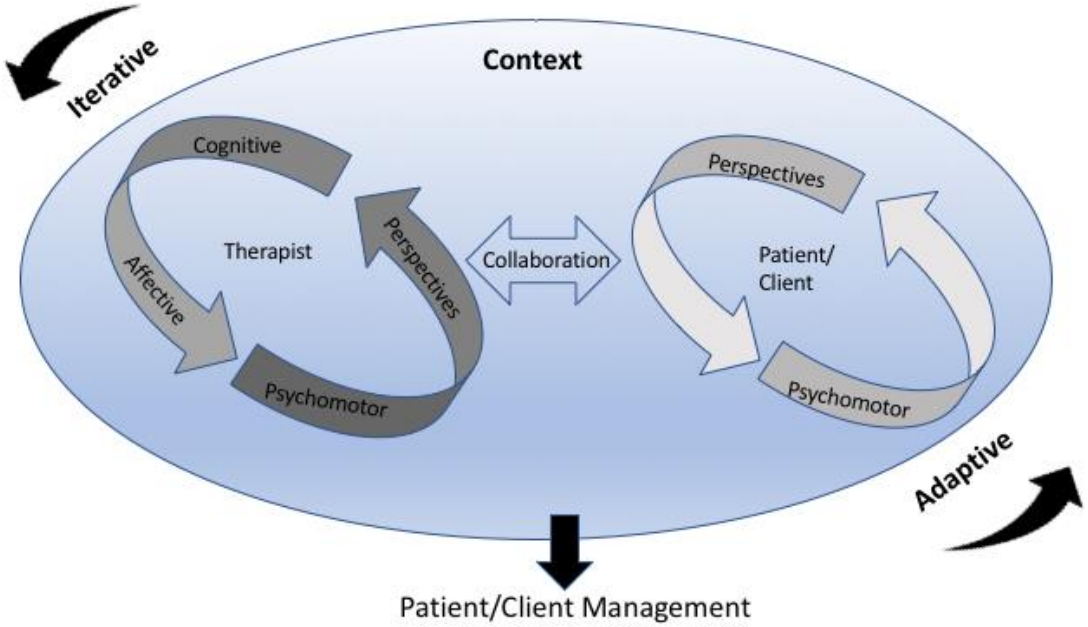

Figure 2: Current state of clinical reasoning derived from the literature.

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Table 1: Search Results

Discipline	Initial Search Results	Retrieved Articles
Psychology	240	28
Veterinary medicine	23	3
Pharmacy	57	13
Nursing	529	99
Medicine	990	234
Health professions	198	51
Total	2037	428

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Table 2: Examples of Data Extraction

Reference	Discipline	Surrogate Terms (Synonyms)	Related Concepts	Antecedents	Consequences	Attributes	Other Contextual Factors
Arocha JF, Wang D, Patel VL. Identifying reasoning strategies in medical decision making: A methodological guide. J. Biomed. Informatics. 2005;38(2):154-171.[60]	Medicine	Medical reasoning; diagnostic process; problem solving	Processes of abstraction, abduction, deduction, and induction; knowledge structures; solution strategies	Problem data	Diagnosis; hypothesis that explains the data	Levels of knowledge; inferences made based on prior knowledge; must minimize variables to manage cognitive load	Reasoning strategies vary amongst clinicians
Ajjawi R, Higgs J. Core components of communication of clinical reasoning: A qualitative study with experienced Australian physiotherapists. *Adv. Health Sci. Educ.* 2012;17(1):107-119.[9]	Physical Therapy		Decision making; diagnostic actions; dynamic process; active listening; metacognition and monitoring; narrative and procedural strategies	Elicit information	Meaning negotiated, goals formed; shared decision making	Rapid, subconscious; Requires narrative and cognitive modes of reasoning; communication and diagnostic actions are not separate	Therapist's "frame of reference" guides the reasoning; patient is part of the reasoning (patient is a reasoner and decision maker)
Austin Z, Gregory PAM, Chiu S. Use of reflection-in-action and self-assessment to promote critical thinking among pharmacy students. American Journal of Pharmaceutical Education 2008[119]	Pharmacy	Critical thinking	Reflection; self-assessment; self-evaluation; thinking; task performance and analysis	Motivation	Those who were prompted to reflect and self-assess scored higher than those who did not	Use of a home grown 24-item critical thinking tool	Describing critical thinking within the context of pen and paper assessment only
Burbach B, Preferred Thinking Style, Symptom Recognition, and Response by Nursing Students During Simulation, Western Journal of Nursing Research, 2015, Vol 37, p. 1563[102]	Nursing	Preferred thinking style	Symptom recognition, simulation, cognitive processing	High fidelity patient simulation, measured symptom recognition and responses.	Significant relationships noted between preference for rational thinking styles and symptom recognition	Rational-experiential inventory	More research needed to explore the cognitive processing during simulation

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Fernbach PM, Darlow A, Sloman SA. Neglect of alternative causes in predictive but not diagnostic reasoning. Psychol. Sci. 2010;21(3):329-336.[124]	Psychology		Predictive reasoning (effects predicted from knowledge of causes); diagnostic reasoning (causes predicted from knowledge of effects)	Information provided	Judgment formed; bias can be based on failure to consider alternative ideas (and will limit precision of assessment); thinking about one way to reach a goal reduces chances alternatives will be considered	Cognitive process, elements of probability; predictive reasoning involves making mental simulations	Underlying beliefs influence bias; specifically asking people to consider opposite ideas may reduce bias

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Table 3: Salient Themes in Each Discipline

	Physical Therapy/ Health Professions	Medicine	Nursing	Pharmacy	Psychology
Attributes	• Intuitive and analytical (tacit and explicit knowledge)[9,153,155,163,182] • Negotiating meaning and shared goals (narrative and analytical reasoning); involves multiple perspectives (client, therapist, etc) bound[9,146-148,150,156-161] • Contextually bound[183] • Diagnosis and management: both are holistic and client centered (includes understanding of contributing factors; involves behavioral change)[146,149,151,152,158-160,162] • Cyclical process involving reflection (on experience and emotions)[147,160,163,182,184] • Therapist's view impacts the process[156] • Engaging the client's body actively; client's embodied knowing[161]	• Dual process [2,23,25,49,52,55,57-59,65-68,70,76-79,82,185,186] • Diagnostic reasoning [2,21-25,49,51,54-56,58-60,64-70] • Decision making for diagnosis and treatment[76-79,82,185,186] • Importance of knowledge organization [2,23,50,51,60,62,71-73,82] • Reflection and deliberate practice [54,64,68,70,77,83] • Contextual factors and bias can influence [21,49,54,76-78] • Involves interaction and communication with the patient[26,83]	• Self-directed critical thinking (but need better assessments)[89-92,94,103,187-190] • Decision making involving relations with patients; contextually driven[99,103,105,107,191] • Reflection in and on action[89,98,107-110,112,191,192] • Knowledge attitudes and skills[193] • Holistic and intuitive thinking[100] • Deductive and pattern recognition (dual process)[97,107,111] • Medical decision making: algorithmic and complex (simplify with algorithm or step by step process)[104,106,194]	•	• Logic and deductive/inductive reasoning (cognitive process)[124,138,195] • Critical thinking[134,139,140] • Biases and beliefs (and heuristics) can influence[124,125,143,145] • Interactive process[195] • Automatic and deliberate thought processes[136] • Requires mental effort[142] • Systematic hypothesis testing[145]

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	Physical Therapy/ Health Professions	Medicine	Nursing	Pharmacy	Psychology
Antecedents	• Elicit information (patient interview: includes patient values) [9,149,151,152] • Observation of the client (client biomedical factors; client needs and goals) and examination [146,150,151] • Interaction with patient/client and family and healthcare team [158,159,161] • Clinical environment, workplace factors[155] • Clinician personal factors (beliefs, values, ethics, motivation)[155,156] • Appropriate knowledge base (patterns/ typical presentations) [147]	• Information presented (patient data, case information)[24,25,27-30,35-37,39,42,43,47,56-60,64,69,76,82,186,196-203] • Data collected (hx, tests, imaging, labs)[26,31,48,81,84,204,205] • Patient presentation, clinical situation (involves uncertainty)[2,8,21-23,33,34,38,41,44-46,79,86,87,206-211] • Context[33,44,64,85-87] • Patient preferences/values[32] • Clinicians' knowledge organization (influenced by bias and experience)[50,53-55,62,63,71-75] • Clinicians' intuition, gut feelings[65,66]	• Vital sign monitoring, symptom monitoring, recognition, noticing [101,102,106,107] • Past experience can influence judgment, anxiety influences[109,191] • Cases and group discussion, data collection[104,111,194,212] • Relationships with patients [105] • Domain specific knowledge (holistic and phenomenological along with analytical)[97,100] • Reflection is necessary[108] • Context[107,213]	•	• Observations and data[122,136,137] • Information [124,125,134,138,140,142,143] • Referral made[145] • Two active participants[195]

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Consequences	• Diagnosis (analysis of disability/ impairments and patient/physical therapist co-construction of meaning) and management (treatment, collaboration, teaching, negotiating future)[147,149,151,152] • Shared meaning and goals negotiated[9,146,158] • Developing a problem list and organized approach to treatment (incomplete if reasoning is not effectives)[153,154] • Teaching and learning of movement[152,159] • Therapist's handling skills impact the outcome[161] • Reflective practice[155,162,163]	• Medical diagnosis (involves diagnostic hypotheses)[2,8,21-60] • Medical diagnosis and treatment plan[10,44,65,66,69,72,76,77,79,80,82,83,85-87,185,186,196-199,201-211,214-217] • Patient safety[81,197] • Efficiency and cost effectiveness[73]	• Surveillance of patients, symptom recognition[101,102] • Analysis of clinical situation, clinical decisions, diagnosis [103-105] • Enhanced patient care (innovative interventions)[93,99,100] • Competence[97,98] • Reflection[107,109,218] • Critical thinking, using a variety of strategies[89,187,190] • Illness scripts[111]	• Application of knowledge to cases[113] • Improved test scores[119,219] • Responsibility associated with critical thinking[121] • Synthesizing concepts[114]	• Informed decisions[122] • Problem solved[140] • Integrated argument formed[142] • Evidence and conclusions evaluated[134,138,143] • Judgment[124,125,136,137] • Plan to address patient needs[195] • Errors if bias influences process[145]

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	Physical Therapy/ Health Professions	Medicine	Nursing	Pharmacy	Psychology
Related Terms	• Decision making[9,146] • Systematic approach[150] • Dialectical (analytical and narrative) [151,153,158,160] • Co-construction of meaning[9,158,159,161] • Knowledge organization (analytical and intuitive)[146] • Metacognition[9,148,160] • Biopsychosocial[148,149] •	• Decision making[56,61-63] • Diagnosis[22,31,56,69,76,78,79,196] • Hypothesis generation [2,8,21,24,36,37,42,79-81] • Dual process (analytical and intuitive) [23,27,30,33,35,49,52,57-59,65,66,68,71,186,198,207,215,216] • Knowledge structure [8,25,31,34,39,42,50,72,74,85,204,208, • 210,220] • Situated cognition[78] • Metacognition/ reflection [35,64,83,218] • Ethical reasoning[32,221] • Emotional intelligence/ interpersonal[49,51,54]	• Critical thinking[88-96] • Reflection on practice [98,107-110,112,191,192] • Decision-making, clinical judgment[89,97,188,191,213] • Cognitive processing (hypothetico-deductive and non-analytical), types of knowing • Problem solving[212] • Creativity[189]	• Critical thinking [113-115,119-121,219,222-224] • Reflection and self-assessment [119,120] • Cognitive flexibility[121]	• Critical thinking [122,134,136,138-140,142-144] • Misconceptions [144] • Intuition[144] • Predictive reasoning[124] • Diagnostic judgments[125] • Intersubjectivity [195] • Dual (deductive and inductive) processes[145,195]

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