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Identification of the Essential Elements in the Clinical Reasoning Process of Health Care Professionals

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Identification of the Essential Elements in the Clinical Reasoning Process of Health Care Professionals

by

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Dedication

To my sons, Cory and Dustin who were my biggest supporters in my journey by giving me endless love and encouragement.

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Identification of the Essential Elements in the Clinical Reasoning Process of Health Care Professionals

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Clinical reasoning is an essential skill all health care professionals must learn and continue to develop. Clinical reasoning combines thinking strategies to reason about a patient's real or potential problem (Delany & Golding, 2014). Health care professionals with poor clinical reasoning skills are prone to miss subtle patient changes thereby failing to prevent patient deterioration (Levitt-Jones et al., 2010). Given that hospitalized patients are more ill than in years past, it is imperative that educators ensure health care professional students graduate with a beginning level of clinical reasoning congruent with safe practice and practicing professionals continue to develop this skill. Patients' conditions can change rapidly often with fatal consequences and health care professionals must be able to interpret these changes and react quickly (Benner, 2010). Despite the current literature on clinical reasoning, the essential elements of the clinical reasoning process have not been identified. The research design used was a Delphi study with a survey that consisted of the potential essential elements and clinical reasoning phases based on a literature review. Content experts from the professions of nursing,

medicine, physical therapy and occupational therapy came to consensus on the essential elements of the clinical reasoning process used by health care professionals. In a two round Delphi study via Survey Monkey(R) the experts identified a final total of 59 essential elements in the clinical reasoning process spread across five phases of clinical reasoning.

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Chapter 1: Introduction of Study

INTRODUCTION

The goal of the research study was to identify the essential elements in the clinical reasoning process of health care professionals. Content experts in clinical reasoning from the professions of nursing, medicine, physical therapy and occupational therapy, were asked to evaluate elements of clinical reasoning identified from the literature using a Delphi methodology. The end result was the identification of the essential elements in the clinical reasoning process as determined by a panel of experts. Chapter One will explain the background and significance of the concept of clinical reasoning and how the absence of clinical reasoning affects patient care. Chapter One will also describe the purpose and goals of the study, present the problem statement, specify the research question and explain the methodology of the study.

BACKGROUND

In the areas of health care professions education and practice, no concept is more important today than the concept of clinical reasoning (Audetat, Sanchez, & Beique, 2013; DeLany & Golding, 2014). Clinical reasoning is an essential competence for health care professionals so they can safely care for the higher acuity patients in today's changing health care system (Rochmawati, & Wiechula, 2010). Today's acute care patients are sicker and more complex than ever before creating new challenges for health care professionals (IOM, 1999). In the 1999 Institute of Medicine report, "To Err is Human", the authors identified thousands of patient injuries and deaths related to errors in both medicine and nursing making patient safety of paramount concern in the health care field (IOM, 1999).

Failure to rescure (FTR) is a term used to describe an untoward patient event and is linked to the quality of patient care and clinical reasoning skills. The New South Wales Health Incident Management System (2006), identified three main reasons for poor patient outcomes. These reasons included the failure to properly diagnose, failure to begin treatment and poor management of complications. The study also identifed that often these critical incidents were due to poor clinical reasoning skills of graduate nurses, pharmacists and physicians (Lapkin, et al., 2010).

In a study by The Agency for Health Care Research Quality (AHRQ) the authors stated "we have argued that FTR may be a better measure for comparing hospital quality because of better severity adjustment properties, and because of its focus on hospital actions" (Failure to rescue, 2016 para 1). The Hospital Engagement Network (HEN) in association with the American Hospital Association has set a goal for each HEN affiliated hospitals to decrease the deaths due to FTR by 40% or maintains a rate of zero for 12 months (FTR, 2016).

Health care professionals are expected to have a high level of thinking and reasoning ability. Patients and their families expect practicing health care professionals to be highly educated with excellent thought processes and reasoning skills. They count on the practicing professionals at the bedside to be able to quickly identify problems in order to prevent or treat resulting difficulties.

With the emphasis on evidenced based practice, one component of clinical practice still misunderstood is the way health care professionals make "diagnostic, therapeutic and management decisions with their patients" (Thomson et al.,2010, p. 82). Clinical reasoning is the foundation of professional practice that beginning health care professionals must learn and practicing professionals must continue to develop. The clinical reasoning process involves more than forming a patient diagnosis (Thompson et al., 2010; Pinnock and Welch, 2010). "It is a critical skill in the health professions,

central to the practice of professional autonomy and it enables practitioners to take wise action, meaning taking the best judged action in a specific context" (Higgs et al., 2008, p. 4). Clinical reasoning is a critical skill that enables health care professionals to identify a patient's real or potential problems, and provide appropriate interventions to solve clinical problems and achieve quality patient outcomes (Carrier et al., 2013).

Clinical reasoning has been described as a bridge between practice and knowledge (Thomson et al., 2010). An important finding in the literature is the emphasis on the importance of developing and enhancing the levels of clinical reasoning of health care professions students. (Higgs et al., 2008; Rochmawati & Wiechla, 2010). Clinical reasoning is a vital component in the education of health professional students (Durning, et al., 2010). Clinical reasoning is the way experienced health care professionals identify and evaluate patient problems leading to clinical decision making and judgment (Faucher et. al., 2012; Higgs et al., 2008).

PROBLEM STATEMENT

Despite numerous research studies and publications about clinical reasoning, there is no consensus regarding the clinical reasoning process or the essential elements that are part of the clinical reasoning process. There is considerable literature describing concepts, theories, and definitions related to clinical reasoning, but no identification nor consensus on the essential elements in the clinical reasoning process (Fonteyn and Grobe, 1993; Norman, 2005; Ramenzi-Badr et al., 2009; Simmons et al., 2003; Thompson et al., 2010).

PURPOSE OF STUDY AND SIGNIFICANCE

The purpose of the study was to identify the essential elements in the clinical reasoning process used by health care professionals. Despite the tremendous amount of research and literature on the clinical reasoning process, there was no research identifying the essential elements that constitute the concept of clinical reasoning.

The significance of the research is directly related to the importance of the concept of clinical reasoning for practicing health care professionals at the bedside and health care professions students. Educators are being called upon to enhance health care professions education to ensure students develop the essential skill of clinical reasoning (Benner et al., 2010; Gilland, 2014; Khatami, & MacEntee, 2011; Norman, 2005). Identification of and consensus on the essential elements will allow educators to evaluate current programs and teaching methods to meet the demand for education of both health care students and practicing health care professionals. Identification of the essential elements will also provide a foundation from which educators can build curricula, clinical experiences and simulation scenarios.

RESEARCH QUESTION

The goal of the study was to identify the essential elements of the clinical reasoning process and seek consensus on these elements from a panel of content experts using a Delphi study. The study consisted of two rounds during which content experts evaluated and agreed on identified essential elements of the clinical reasoning process of health care professionals. The research question was: What are the essential elements of the clinical reasoning process of health care professionals? The long term goal for the proposed study is that researchers will be able to use the identified essential elements to investigate how to teach, develop and evaluate clinical reasoning in health care

professions students. By ensuring the consistent evaluation and development of clinical reasoning in students, patient care can be positively affected, patient safety increased and quality of patient care will be improved.

OVERVIEW OF METHODOLOGY

The Delphi methodology used for the study was a traditional Delphi study using a Likert type questionnaire with a comment section under each question in round one. Survey Monkey® was utilized to deliver the questionnaire to the content experts. A total of two rounds were completed. The methodology was selected because it allowed content experts from different health care professions, in different parts of the world, to participate without undue burdens, such as traveling to a meeting to voice their opinions on the elements. The Delphi study included an in-depth review of the literature to identify potential elements of the clinical reasoning process, construction of the survey, and analysis of results of both rounds of the survey.

METHODOLOGY - BENEFITS AND LIMITATIONS

The primary advantage of the Delphi study is the ability of the researcher to objectively and anonymously explore issues that require expert opinion and gain a consensus on a particular facet of the topic at hand. The weakness or problems that can occur include subject attrition, large amounts of time for multi-round studies, and the necessary time and attention to detail for the method to be successful (Yousuf, 2007).

The Delphi study also has a potential for failure. There are several reasons cited for failure such as organizing the Delphi structure to prohibit or inhibit an expert's contributions of other perspectives. Other reasons for failure include poor summarization techniques used when organizing the follow up to questionnaires for succeeding rounds, failure to explore disagreements from participants thus limiting new data or creative

responses from participants, and failure to recognize that participants in the Delphi study are generously giving of their time and the lack of compensation (Yousuf, 2007).

ORGANIZATION OF THE STUDY

The following chapters will describe the elements of the research study. Chapter two presents an in-depth literature review of the concept of clinical reasoning including definitions, pertinent research studies, theories of reasoning, components of the reasoning process and evaluation of the clinical reasoning process in the different health care professions. Chapter three describes the methodology used to ascertain the essential elements. Chapter three will include a description of how the proposed elements were identified from the literature of health care professions. Secondly, chapter three contains the process of identifying and selecting content experts in clinical reasoning. Lastly, the methodology chapter includes the process for survey development for the first and second rounds of the Delphi study. Chapter four consists of the findings of the study including the demographic data describing the content experts and the analysis of the survey data from each round of the study. Chapter five summarizes the findings of the study, compares the findings to the literature, describes limitations and outlines recommendations for future research.

Summary

The researchers of clinical reasoning identified concepts and theories about clinical reasoning but has not identified the essential elements crucial for the clinical reasoning process. The importance of ensuring health care professional students and practicing professionals learn and develop clinical reasoning is indicated by the increasing literature on the problem of failure to rescue and the incidence of patient deaths related to errors by health care professionals (IOM, 1999). The definitive goal for the research study was to establish the essential elements of clinical reasoning. The long

term goal was to use the essential elements of clinical reasoning to develop education, define competencies and create methods of evaluation based on the essential elements. The long term goal is intended to assure health care professions students and practicing professionals can competently use the skill of clinical reasoning.

Chapter 2: Literature Review

Introduction

Clinical reasoning is the foundation of professional health care practice. Beginning health care professionals should learn the process and practicing professionals must continue to develop it. The clinical reasoning process involves more than arriving at a patient diagnosis (Pinnock and Welch, 2013; Thompson et al., 2010). "It is a critical skill in the health professions, central to the practice of professional autonomy and it enables practitioners to take wise action meaning taking the best judged action in a specific context" (Higgs et al., 2008, p. 4).

Chapter Two details the review of the literature on the concept of clinical reasoning to include definitions, the use of clinical reasoning in practicing health care professionals. Chapter two will also present the interrelated concepts of reasoning, problem solving and expertise seen as essential components in the clinical reasoning process. Chapter Two will also provide the research history of the clinical reasoning process as well as research completed to examine the clinical reasoning process and theories pertaining to clinical reasoning in each of the professions.

A literature search was performed using Ovid, Medline, Psych Info and CINAHL databases including the years 1970 to the present. The keywords included clinical reasoning, critical thinking, clinical decision making, and clinical judgment. Initially six professionals were included in the search: nursing, medicine physical therapy,

occupational therapy, pharmacy, and respiratory therapy. Professions were eliminated from the study if there were fewer than two journal articles related to clinical reasoning for a given profession. No literature was found for pharmacy or respiratory therapy. The final professions identified included nursing, medicine, physical therapy and occupational therapy.

A search on the concept of clinical reasoning resulted in the identification of 237,420 journal articles, and 10 books for the professions of nursing, medicine, physical therapy and occupational therapy. A final number of 174 journal articles and 10 books were identified for potential use in the study. Journal articles were retained if they gave a historical account of the research in clinical reasoning, contained elements of the clinical reasoning process, researched the clinical reasoning process of experts versus novices, or contained relevant information related to the clinical reasoning process in the health care professions. To present a full and complete review of the literature associated with the potential essential elements of the clinical reasoning process, the concepts of reasoning, expertise and problem solving were included in the literature search and review.

The literature review encompassed journal articles going back to the 1970s to ensure the inclusion of seminal literature on clinical reasoning. In the literature, the term clinical reasoning has been used synonymously with the terms critical thinking, clinical judgment, clinical decision making, clinical problem solving, diagnostic reasoning, and medical problem solving (Elstein, 2009; Jones, 1992; Marcum, 2012; Thomson et al., 2010). The continuous mixture of terms has created confusion in the research on clinical

reasoning (Thomson et al., 2010). The use of synonymous terms for clinical reasoning was evident throughout the literature review.

The literature review on the concept of clinical reasoning resulted in the identification of two major categories of literature. The first category of literature included concept analyses and comprehensive literature reviews (Coulter, 1998; Durning et al., 2012; Fonteyn & Grobe, 1993; Norman, 2005; Pinnock &Welch, 2013; Simmons, 2010). The second category included the identification of themes and concepts related to clinical reasoning through various studies evaluating clinical reasoning in health care students and practicing professionals (Durning, et al., 2012; Fonteyn & Grobe, 1993; Gilland, 2014; Ramenzi-Badr et al. 2009; Simmons et al., 2003). However, in the review of literature there was no identification of specific or essential elements of clinical reasoning or an established consensus on these elements. There were, however, similarly themed concepts labeled with different names among the different health care professions. The next section will present the definitions of clinical reasoning in the different health care professions.

Definitions of Clinical Reasoning

Clinical reasoning is used by all health care professionals and each profession has defined clinical reasoning specifically to their profession. In nursing, Simmons (2003) defined clinical reasoning as "a recursive cognitive process that uses both inductive and deductive cognitive skills to simultaneously gather and evaluate assessment data" (p. 702). Benner et al., (2010) described clinical reasoning as "the ability to reason as a

clinical situation changes, taking into account the context and concerns of the patient and family" (p.85).

Historically, nursing education has centered on the nursing process, utilizing the five processes of assessment, diagnosis, planning, implementation and evaluation. Fonteyn and Ritter (2008) stated the nursing process should not be seen as synonymous with the clinical reasoning process. A student nurse's reasoning process learned in nursing school is different from the reasoning required in daily practice. The nursing process teaches nursing students to see a patient's problems and resulting interventions as separate parts of the process, and the separation of the processes may actually slow the reasoning process and may not reflect reasoning essential for daily practice, when co-morbidities or changing patient status may occur simultaneously (Fonteyn & Ritter, 2008). Next will be definitions of clinical reasoning from the profession of medicine.

Researchers in the medical profession have defined clinical reasoning in a variety of ways using similar, but distinct language. Examples include "a process of thinking and interacting with the environment to understand clinical situations, to make diagnostic and therapeutic decisions and to frame and solve clinical problems" (Khatami & MacEntee, 2011, p. 321), "the thinking and decision making processes that are associated with clinical practice" (Faucher, 2012, p. 1774), "establishing the diagnosis and deciding on a plan for action that is specific to the patient's circumstances and preferences" (Durning et al., 2011 p. 928) and "a form of cognition applied to evaluating and managing a patient's medical problem" (Braude 2012 p. 945).

Clinical reasoning in physical therapy has been defined as "the cognitive processes, or thinking used in the evaluation and management of a patient" (Jones, 1992,

p. 876). “Five dimensions identified in the process include cognition, a discipline-specific knowledge base, metacognition, the role of the patient in the decision making process, and contextual interaction” (Holdar et al.,2013, p. 221). Factors affecting clinical reasoning include the task, the context, the patient and the clinician. Ajjawi and Higgs (2007) defined clinical reasoning as “a thinking and decision making process associated with professional practice” (p.134). Oberg et al., (2015) defined clinical reasoning as “professional judgments made before, during and after clinical sessions in physical therapy” (p. 244). Jones (1992) defined clinical reasoning in physical therapy as “the cognitive processes, or thinking used in the evaluation and management of a patient” (p.186). Clinical reasoning is the cognitive process used in the examination and treatment of a patient (Holdar et al., 2013).

Shell (2009) defined clinical reasoning in occupational therapy as “the processes practitioners use to plan, direct, perform and reflect on client care” (p. 314). Clinical reasoning has also been defined as how occupational therapy practitioners solve problems and come to decisions about patient care (Carrier, 2013). Mattingly (1991) defined clinical reasoning as “a largely tacit, highly imagistic and deeply phenomenological mode of thinking” (p. 979). Clinical reasoning is seen as a critical factor affecting the practitioner’s choice of interventions (Carrier et al., 2013). The definition of clinical reasoning for the present study is, a process of identifying a patient’s real or potential problem, collecting and analyzing data, hypothesizing and determining a treatment, and evaluating and reflecting on the process to determine if the treatment is working.

The different health care professions have similar themes in their definitions of clinical reasoning. These themes include: 1) a process used to plan and decide a

patient's diagnosis and treatment, 2) a cognitive or thinking process used in the evaluation and management of patient's problems, and 3) strategies used to identify and treat a patient's problem. The above similar themes identified also extend to the concepts found in research studies examining clinical reasoning in the different health care professions.

Despite the variances in the definition of clinical reasoning in the different health care professions, a common area of understanding is the importance of the clinical reasoning process in daily practice. Even though the specific situations for the use of clinical reasoning may vary, the need to understand and use clinical reasoning is the same for all professions. The next paragraphs will present the importance of clinical reasoning in each of the health care professions practice

Clinical Reasoning in Practice

Clinical reasoning is the methodology used by experienced and expert nurses to continually monitor their patients' status (Banning, 2008). Research on patient deterioration indicates subtle signs and symptoms are presented 3-24 hours before the patient shows obvious signs of deterioration. A nurse's failure to identify and respond to these signs may result in a poor patient outcome and a higher mortality rate (Hodgetts et al., 2005). Nurses with poor clinical reasoning skills are prone to miss the subtle changes in their patients' status thereby failing to prevent further deterioration of a patient's condition (Levitt-Jones et al., 2010). Benner et al., (2010) noted a nurse's clinical reasoning ability is a core skill. Nurses must be able to quickly come to a conclusion and react to a patient's situation.

For physicians, clinical reasoning is an essential skill. It is used to come to a decision about a patient's diagnosis and treatment plan. It is seen as a vital part of a physician's practice (Bordage & Lemieux, 1991; Durning, et al., 2013; Loftus, 2012; Neufeld et al., 1981; Norman, 2005). The factors affecting the clinical reasoning process in medicine include the number of domain specific experiences and content knowledge (Durning et al., 2013). Contributing factors affecting the clinical reasoning process include problem solving skills, contextual factors, expertise level, context specificity, content knowledge, intuition, heuristics and bias (Bordage & Lemieux, 1991; McBee et al., 2015; Durning et al., 2013; Crespo, et al., 2004; Eva et al., 2007; Elstein, 1999; Neufeld et al., 1981; Pinnock & Welch, 2013; Schmidt & Rikers, 2007).

In physical therapy clinical reasoning is seen as a vital skill for the clinician to possess and the novice to learn (Gilland, 2014; Oberg et al., 2015). Clinical reasoning in physical therapy signifies the physical therapist's decisions about a patient's plan of care and is hypothesis driven. Clinicians in physical therapy utilize two different types of knowledge in the clinical reasoning process, propositional and non-propositional. Propositional knowledge refers to theoretical knowledge. Non propositional knowledge refers to experience based knowledge (Higgs, Jones, & Tichen, 2008).

Clinical reasoning for practicing occupational therapists and students encompasses a broader and more involved process than other professions (Mattingly & Fleming, 1994). Factors contributing to the clinical reasoning process in occupational therapy include the institution's values and limitations, the patients and their living situations, scientific knowledge, and the therapist's beliefs and values. One of the goals of the clinical reasoning process in occupational therapy includes "determining the

meaning of the disability from the client's perspective." (Chapparo & Ranka, 2008, p. 269). To determine the meaning of the disability for the patient, five types of knowledge should be known. The five types of knowledge are, the patient's motivation, wishes and endurance, the conditions and living circumstances where the patient will complete the task, the patient's abilities and problems, insight about the current relationship with the patient to include implied rules and boundaries and projected outcomes for the patient (Chapparo & Ranka, 2008).

The patient data are continually updated to provide ongoing data and current information to revise the treatment plan. The process of clinical reasoning in occupational therapy involves collecting and analyzing patient data to include information about the patient's capability and living circumstances. The therapist then uses the data to identify the patient's problems, treatment and goals (Chapparo & Ranka, 2008).

There are several types of reasoning used by occupational therapists in the clinical reasoning process. They are scientific reasoning, narrative reasoning, ethical reasoning, conditional reasoning and pragmatic reasoning (Chapparo & Ranka, 2008). Scientific reasoning includes diagnostic reasoning and procedural reasoning. The concepts associated with scientific reasoning include: "cue acquisition, hypothesis generation, cue interpretation and hypothesis evaluation" (Chapparo & Ranka, 2008, p. 272). Procedural reasoning refers to the clinical reasoning process used when identifying problem definition and treatments (Unsworth, 2001). Narrative reasoning encompasses understanding the disability and treatment from the patient's perspective. Ethical reasoning entails how the therapist's values affect the clinical reasoning process. Conditional reasoning involves predicting the effect the desired outcome will have on a

patient's future life. Pragmatic reasoning is when the therapists must consider what is attainable for a patient in the context of the environment. Mechanisms affecting narrative reasoning include reimbursement issues, current therapy trends, resources and institutional restraints (Chapparo & Ranka, 2008; Mattingly & Fleming, 1994). The next section will present the interrelated concepts embedded in the clinical reasoning process.

Interrelated Concepts

Health care professions researchers have examined several concepts related to clinical reasoning attempting to ascertain the importance of the concepts to the clinical reasoning process. The concepts identified in clinical reasoning research have been labeled as interrelated concepts as they are an integral part of the clinical reasoning process. The interrelated concepts associated with the current study of clinical reasoning include the concepts of reasoning, problem solving and expertise. First, reasoning provides the foundation for the clinical reasoning process. Second, the clinical reasoning process is a problem solving process that is used to identify and treat a patient's problem. Third, levels of expertise influence the pathway of a healthcare professional's clinical reasoning process. The next section will summarize the history and major theories of reasoning, the problem solving process and the research on the levels of expertise.

Theories of Reasoning

To begin identifying the essential elements of clinical reasoning it is important to look at the definition, theories and models of reasoning which provide the foundation for the clinical reasoning process. The reasoning process allows people to move from existing knowledge to new knowledge (Greenwood, 1998). According to Merriam-Webster Online Dictionary (2010), reasoning is defined as the drawing of inferences or

conclusions using reason. Reasoning can also be seen as a "form of thinking that is often apparent during the presentation of ideas or discourse in which the logistics of an argument are collated in a logical manner in order to reach a rational conclusion" (Banning, 2008, p. 178) Since the l920s, there have been numerous theories on how humans reason (Evans, 2002).

Formal and Informal Reasoning

There are two main types of reasoning, formal and informal reasoning. Formal reasoning includes problems of logic and is often used in studies of reasoning when all the information about a situation is given in advance. The subject is not asked to use other resources, just the information provided to solve the problem. Formal reasoning is often easier to measure due to the nature of the problems presented in these studies and the fact that answers to the problem presented are often clearly right (Galotti, 1989). The second type of reasoning is informal reasoning or the type used in everyday life such as in planning, discovering and making choices. Individuals using informal reasoning are able to draw on different resources, knowledge and backgrounds to make decisions (Galotti, 1989; Radvansky & Copeland 2004).

Deductive-Logical Reasoning

The psychology of reasoning for many years was centered on the idea of the deductive-logical reasoning paradigm. The paradigm followed the belief that when people are asked to come to a valid conclusion for a specific problem it will be based on logic (Evans, 2002). Beginning in the 1960's to present day, researchers completed numerous studies in an attempt to substantiate the paradigm of logic based reasoning (Evans, 2002). However, the research showed people in these logic experiments

responded very poorly and were predisposed to make logical errors (Evans, 2002). Research also showed the responses were based on problem content and context rather than logic (Evans, 2002). One of the questions evolving from these experiments was, "Do people reason logically and ought to people reason logically?" (Evans, 2002 p. 978). Psychologists concluded from studies of logical reasoning that people were in fact illogical and irrational. "The psychological debate centered on whether people were inherently logical or illogical" (Evans, 2002, p 980). The findings of the logic experiments showed "people trained in formal logic could make valid arguments in these clinical situations at above chance rates and is strongly linked to general intelligence" (Evans, 2002, p 982). From the results of studies of reasoning by logic, other questions emerged about the influence of content and context and how prior knowledge and beliefs affected reasoning (Evans, 2002). In these experiments researchers found people had a tendency to assess problems using prior knowledge and beliefs (Evans, 2002). The failure of research to support the belief that people reason logically has lessened the belief in the pure logical model of reasoning researchers once endorsed (Evans, 2002).

Mental Model Theory

In 1983, Johnson-Laird presented his Mental Model Theory of reasoning. The theory's major premises were "people make logical errors and fallacies must be explained; people are influenced by non-logical heuristics; reasoning is influenced by problem content" (Evans, 2002, p. 985). Johnson-Laird also questioned whether there was inborn logic, and if so what was the source. In his theory "mental models represented the many possible situations in the world" (Evans, 2002, p 986). He believed when deciding if an argument is true, people try to find alternative conclusions. If they

could not find an alternative conclusion, then they would accept the argument as true. Johnson's mental model theory has become the major framework for current reasoning research (Evans, 2002).

Dual Processing Theory

Another major component of reasoning research is the Dual Processing Theory, coming to light in the l970s. The Dual Processing theory inferred reasoning involved two different and distinct systems of thinking, one using logic and the other no logic. System one is called the implicit system, and is an automatic and unconscious system driven by past learning. It displays the characteristics of being contextualized, has high processing capacity, and is driven by learning and related to general intelligence. System two is the explicit system and is conscious and controllable and restricted by the working memory capability (Evans, 2002). It has the characteristics of both logic and the abstract. Individuals using system two, the explicit system, reach conclusions on generalizations rather than on factual information. System two is also affected by general intelligence and limited by a person's working memory (Barrouilett, 2011; Evans, 2002; Galotti, 1989).

The review of the theories and models of reasoning indicated there is no single accepted theory or model of reasoning to date. However prior research has given today's researcher's definite ideas about the concept of reasoning. The research showed deductive or logical reasoning has a place in some real world situations. Logical reasoning is useful when people need to understand and follow the rules, and apply them to individual situations, in occupations such as mechanics, tax preparers and computer programmers (Evans, 2002). Understanding the concept of reasoning is important as reasoning is the foundation of the clinical reasoning process.

Health care professionals apply the concept of reasoning every day in practice and to patient care situations. To understand clinical reasoning and identify the essential elements it is important to distinguish clinical reasoning from other similar concepts. In the area of health care professions education and practice, understanding the fundamental elements of reasoning is a vital part of the clinical reasoning process (Durning et al., 2011). An interrelated concept embedded in the clinical reasoning process is problem solving.

Problem Solving

To begin discussing problem solving, one must first look at the definition of a problem. A problem has been defined as the following: "A human being is confronted with a problem when he has accepted a task but does not know how to carry it out" (Simon, 1978, p. 291). Problem solving is an integral part of the clinical reasoning process. Definitions of clinical reasoning often integrate the idea of a problem. For example, one definition of clinical reasoning states it is "a process nurses use to understand the significance of patient data, to identify and diagnose actual or potential patient problems" (Simmons et al., 2003 p. 702). Clinical reasoning models are often referred to as problem solving models. "Healthcare professionals form a diagnosis of the clinical problem, plan and determine treatment goals and intervention by using the cognitive process involving information processing, problem solving, judgment and decision making" (Smyrni & Nikopoulos, 2007 p. 1130). There have been several research studies completed on the problem solving process.

Polya (1945) and Lindsay (1947) completed some of the earliest work on problem solving and their work is still relevant today. Polya (1945), a mathematician, believed when solving a problem, you must first understand what the problem is asking, any limitations or conditions to the problem, the goal, the context and the information presented in the problem. The person will then devise a plan of action to determine how to solve the problem (Polya, 1945).

Lindsay (1977) researched how people solve problems. Some basic problem solving strategies identified included forward searching and backwards working. The forward searching process begins by trying a method and deciding if any progress has been made towards finding the correct answer. If progress is made, one continues moving in a forward direction from where the last step finished. The backwards process begins by working from the solution and determining what previous step had to be made to get to the solution. An individual continues moving in a backwards direction from the solution to the beginning of the problem. "Backwards search uses a heuristic entitled means-end analysis" (Lindsay, 1977, p. 512).

Strategies for solving problems can be divided into two types, algorithms and heuristics. Algorithms can be thought of as sets of rules used to solve a problem. If the person follows these rules the problem will be solved correctly. An example of an algorithm would be the rules for solving multiplication problems. Heuristics are procedures used to solve the problem, however, finding the solution to the problem is not guaranteed with heuristics. Heuristics is a strategy commonly used in complex problems. A type of heuristics used frequently in the clinical reasoning process is recognizing similarities in the current problem to a past problem (Lindsay, 1977).

Newell, Shaw and Simon (1958) developed a theory of human problem solving using complex tasks. The researchers compared the programmed problem solving ability of a computer program, The Logic Theorist (LT), to problem solving in humans. The Logic Theorist was programed with expressions and theories to assist it in solving problems. Results showed LT was "qualitatively like that of a human faced with the same task" (p. 155). The comparison of LT to human problem solving revealed two important findings. First, LT used heuristic processes in solving problems, and second, the success of LT depended on the order of the problems presented.

Schoen (1983), in his book *The Reflective Practitioner*: *How Professionals Think*, discusses a professional's problem solving from the perspective of technical rationality. He noted problems are solved by selecting the best choice from those presented. Schoen believed one factor affecting problem solving was the problem setting. The problem setting is defined as "the process by which we define the decision to be made, the ends to be achieved and the means which may be chosen" (p. 44). He went on to say problems are not presented to be solved, but are "constructed from problematic situations which are puzzling, troubling and uncertain" (p. 44). In order to change a "problematic situation" to a problem to solve, a person must start by understanding a confusing situation. Although problem setting is a component of problem solving, the person determines which items he/she will identify as the components of, and context of the problem. In order to solve a problem with science, applied research, or a theory, there needs to be an "agreement about the ends" (p. 44).

Expertise

Another interrelated concept important in the clinical reasoning process is expertise. A major component identified in the literature review of clinical reasoning in all the health care professions was the research on how experts reason and the differences between expert and novice clinicians. The research on expertise in any domain is a complex subject, however, the following will address some of the major theories and research areas pertaining to the development and characteristics of expertise. De Groot (1978) completed some of the earliest research on expertise in his study of chess masters. De Groot utilized the think aloud protocol with chess players of varying levels while they decided on moves for different chess positions. By having chess players express their thinking or reasoning aloud, he found the more successful chess players selected moves superior to the weaker chess players. DeGroot's finding indicated the job of choosing moves stimulated a cognitive process allowing for distinction between players at different levels of expertise (Ericsson & Smith, 1991).

Dreyfus & Dreyfus (1986) completed seminal research on the development and characteristics of expertise using pilots, chess players, drivers and adult learners of a second language as subjects. The findings of their study identified commonalities in all of the professional areas described as the five stages of skill acquisition (Dreyfus & Dreyfus, 1986). They termed the five stages: novice, advanced beginner, competent, proficient and expert. The following is a description of the characteristics of each stage.

A novice learns to identify objective features relevant to a particular skill and uses rules to decide on an action. Factors in a situation are clearly defined and recognizable so the novice will not have to take into account the context of the situation to determine an

action, known as “context free rules” (Dreyfus & Dreyfus, 1986, p. 21). The novice will use information processing to make decisions for a situation.

The advanced beginner’s performance will improve due to experience in real world situations. The advanced beginner will start to use situational elements in the decision making process as they begin to identify and recognize those elements particular to a situation. For the competent performer, the number of context free rules and situational elements become overpowering.

The competent performer cannot determine what is important in a particular situation. To overcome the problem, the competent person will develop a hierarchical process in making a decision. By organizing a situation and placing the facts in small categories to consider, competent performers are able to streamline the decision making process and improve their performance.

The proficient performer will likely be immersed in the situation at hand. The proficient performer will encounter the situation from a perspective based on the events at hand. An example would be a proficient nurse who is concerned about a patient’s deterioration. The proficient nurse will be focused on the aspects of the patient’s condition that is causing the decline in the patient’s status. The perspective will facilitate the recognition of distinctive features in the situation that come to the forefront while other features will fade to the background. As the situation changes, so will the features given more importance. These characteristics of the situation are due to the performer’s recognition of similar situations and the use of intuition (Dreyfus & Dreyfus, 1986).

Dreyfus and Dreyfus, (1986) defined intuition as “neither wild guessing nor supernatural inspiration, but the sort of ability we all use all the time as we go ahead

about our everyday tasks" (p. 29). The key aspects of intuition include pattern recognition, similarity recognition, commonsense understanding, skilled know-how, sense of salience and deliberative rationality. The expert or intuitive performer will be able to subconsciously understand the situation and at the same time be thinking analytically about the decision at hand. The expert performer recognizes how to respond to a situation based on a mature and practiced understanding. The expert's skills have evolved so it is a part of him/her at an unconscious level. The actions and decision the expert makes are fluid, almost seeming automatic and instinctive. The expert skill level must be maintained through continued practice in the area of expertise. Without practice the expert may resort to earlier levels when confronted with a particular situation (Dreyfus & Dreyfus, 1986). Expertise is associated with clinical reasoning as numerous studies have attempted to understand clinical reasoning better by studying the difference in the expert's and novice's clinical reasoning process, and expertise is seen as one of the necessary components to the clinical reasoning processes. (Elstein,et al., 1990; Neufeld et al., 1981; Norman et al., 2007; Pinnock & Welch, 2013).

Research Comparing Novice and Expert

The next section will present research studies that compared expert and novice health care professionals. Researchers completed a study to determine the difference between first-year and third-year physiotherapy students' patterns of reasoning using a clinical case scenario and the Think-Aloud Technique. The students evaluated and designed a treatment plan for the simulated patient. The student's hypotheses and assessments were coded using the international Classification of Functioning Disability and Health. The results showed the first year students reasoning processes focused on the

body's anatomical structures while the third year students focused on medical diagnosis. For the treatment plan, third year students included more attention to the patient as an individual than first year students (Gilland, 2014).

A qualitative study compared three master and three novice orthopedic physical therapy clinician's clinical reasoning skills. Data collection included observation, audio taping, interviews and recorded reviews. Findings indicted there were five "attribute dimensions" that differentiated the master and novice clinician. One knowledge attribute identified was confidence in predicting patient outcomes. There were four attributes related to patient treatment performance, which described "what actually happens when the therapist is treating patients" (Jenson et al,, 1992, p. 37).

Wainwright et al. (2011) completed a study to examine the decision making abilities and process therapists and factors affecting the process. The researchers used semi structured interviews and observation of novice and expert therapists during patient evaluation and treatment sessions. The evolution of the clinical decision making process began with the hypothetico-deductive process, used primarily by novice clinicians, and transitioned to the expert clinicians process of forward reasoning which entailed using pattern recognition and development of a diagnosis derived from the data. The process was known as the "stage theory of clinical reasoning" (Wainwright et al., 2011 p. 88). From the study, five themes were identified as factors of the decision making process, which included: "1) mentorship, 2) information from the literature, 3) continuing education, 4) clinical experience, and 5) critical thinking" (Wainwright et al. pg. 96).

Hoben, Varley and Cox (2007), researched masters and undergraduate speech and language therapy students to determine the differences in their clinical reasoning skills.

Eight master's and twenty-six undergraduate occupational therapy students participated. The participants were placed in pairs and instructed to determine the diagnosis of one of three simulated patients. Think aloud protocol was used as well as video recording and the completion of a learning log. Participant pairs were categorized as "diagnostically accurate or inaccurate" based on whether they identified a diagnosis for their case study patient. Results showed the diagnostically accurate pairs used precise and specialized terminology and more concrete diagnostic statements. For the diagnostic inaccurate participants there was a failure to explain test results and a difficulty in coordinating appropriate tests for a diagnosis and problems remembering theoretical information. The researchers concluded novice therapists have difficulty in conceptualizing problems at a deeper level, planning diagnostic strategies, organizing information, interpreting data and evaluating progress. The finding of the study can aid educators in developing strategies to enhance the clinical reasoning process in students.

Benner (1984) used a hermeneutic phenomenological approach to explain and apply the Dreyfus Model of Skill Acquisition in the practice of 130 critical care nurses. The study's findings indicated that nurses at different experience levels had different clinical worlds and it affected their judgment and perception of their patients. The findings aligned with the Dreyfus and Dreyfus (1980) novice expert research which outlined the characteristics of each stage of skill development. The novice followed rules to perform patient care actions. The advanced beginner has acquired enough experience to exhibit acceptable patient care performance and identify situational components. The competent performer in one who has enough experience to identify long range plans to complete patient care. The proficient nurses are one who can perceive the patient care

situation as a whole and has enough experience to expect typical events that can occur in patient care (Benner, 1984).

The above studies examined the differences in the clinical reasoning process in expert and novice health care professional. Results of the studies identified how the expert is able to quickly begin identifying the patient problem by generating hypothesis and using pattern recognition. The expert health care professional was also able to see the patient more as an individual rather than a disability or disease process. The concept of expertise is related to the clinical reasoning process because as the research studies above have shown, an expert's clinical reasoning process has different characteristics compared to a novice's processes. The novice still needs to acquire experience and skill to improve clinical reasoning ability.

Clinical Reasoning in the Health Professions

The next section will summarize the theories used to study clinical reasoning in health care professionals. There have been a variety of theories used in the different health care professions to research the clinical reasoning process. Theories used in medical research, such as the hypothetico-deductive theory have had a strong influence in the research of the concept. What follows is a synopsis of the history of research on clinical reasoning and research completed to enhance the knowledge of the clinical reasoning process.

History of Research on Clinical Reasoning

The early research on clinical reasoning occurred primarily in medicine and has influenced the majority of research on clinical reasoning in all the health care professions.

Researchers attempted to understand a physician's, both expert's and novice's information processes and organization of knowledge when examining a patient. The studies were conducted utilizing a think aloud protocol or verbalization process in an attempt to understand clinical reasoning (Elstein, et al., 1990; Neufeld et al., 1981; Norman et al., 2007; Pinnock & Welch, 2013). The findings of the studies highlighted one of the problems with the research protocol. The subject had difficulty articulating how their thought process operated (Durning, et al., 2011; McBee et al., 2015).

Several researchers compared the clinical reasoning processes of experienced clinicians and medical students. Groups of expert clinicians and students were observed while they worked with patients. Both groups quickly developed diagnostic hypotheses and gathered data to evaluate these hypotheses. The participants' reasoning processes were very general and both groups used the same process. The distinguishing factor between the two groups was the quality of diagnoses the experts developed. It was hypothesized expert clinicians used forward reasoning, pattern recognition or categorization when there was a familiar clinical problem presentation. Novice providers and medical students had difficulty developing a plan, and some novices could not go beyond data collection to begin developing a hypothesis (Elstein, & Schwarz, 2002). When a problem cannot be readily identified or is complicated both clinician groups will use hypothesis testing. Both the experienced clinician and a first year medical student were able to develop a like number of hypotheses. The fact that both expert and novice were able to develop a similar number of hypotheses demonstrated experience was not a factor in the amount of hypotheses both groups developed. (Elstein et al., 1990; Norman, 2005, Schwartz & Elstein, 2008; Norman, Young, & Brooks, 2007).

It was found the problem solving process greatly differed between individuals depending on the level of content mastery. The finding challenged the hypothetico–deductive theory as both experienced and novice providers were able to develop hypotheses (Elstein & Schwarz, 2002). Another concern was successful completion of one type of problem did not mean success on another problem. The factor was labeled content specificity (Elstein, et al., 1990; Norman, 2005). The finding of content specificity implied problem solving was dependent on the content knowledge of the clinician and not just experience (Elstein, et al., 1990). Researchers recognized these factors did nothing to endorse the problem solving theory nor the idea that the clinical reasoning process was based entirely on the level of expertise (Durning et al., 2013; Schmidt et al., 1990).

During the same time period, research completed on chess masters determined experts in chess were able to memorize up to 50,000 positions seen in prior games. The player's ability to recall positions was dependent on his ability to identify familiar patterns or chunks (Charness, 1991; Pinnock & Welch, 2013; Elstein, et al., 1990; Elstein. & Schwarz, 2002). It was thought chess masters and clinicians used clinical reasoning in the same manner. However, it was later determined a health care clinician's memorization of minute details of prior patients' presentations alone did not improve his/her clinical reasoning skills (Pinnock & Welch, 2013; Norman, 2005). There were attempts to duplicate the research generated on memory of expert chess masters with physicians. There was little success in duplicating the research and it was hypothesized the memorization of chess moves is a critical factor for a successful chess player. However, unlike the chess masters, the large amount of stored general medical

knowledge of a physician was not readily available to use and was not necessarily a measure of expertise (Elstein et al., 1990).

Another area of research involved the concept of mental representations and organization of knowledge. Mental representations are ways in which knowledge is organized for recall. Schmidt et al. (1990) described a developmental stage theory linked to experience. Experienced clinicians moved through the different stages when developing a hypothesis. These stages included basic science or causal knowledge (mechanism of disease) illness scripts (signs and symptoms), and exemplars (Norman, 2005). Experts are better at clinical reasoning because their knowledge is stored in networks for easier recall. Studies completed on memory recall showed expert clinicians resorted to basic science knowledge in difficult cases, but not in simple cases (Norman, 2005; (Pinnock & Welch, 2013; Schmidt et al., 1990).

Decision making theory was also used to study clinical reasoning in medicine and was based on Bayes Theorem, a mathematical probability formula. The theory depicted medical decision making as "process of reasoning about uncertainty updating an opinion with imperfect information" (Elstein & Schwartz, 2002 p. 730). Heuristics and bias are the concepts associated with Bayes Theorem, and the theorem explains "how we should reason but it does not describe how opinions are revised." (Elstein & Schwartz, 2002 p. 730). As new information is obtained about a situation, the probability for each diagnosis is updated. Decision making theory is used to calculate the best possible options for a patient problem. The theory focuses on two types of errors, pretest probability and strength of the data. It works well with evidenced based medicine and determines the best options for populations of patients using logic and rationality (Elstein & Schwartz,

2002; Schwartz & Elstein, 2008). However, the theory's weakness is the inability to factor in interpersonal influences and subjectivity in a patient situation.

One of the more recent information processing theories used to describe the clinical reasoning process in medicine is the cognitive continuum theory. It is an "adaptive theory of human judgment" incorporating intuition and analysis (Dunwoody et al., 2000). The theory postulates the idea of a "continuum where analysis and intuition are located at each end" of the spectrum (Bjork & Hamilton, 2011p. 2). A major component of the theory is "judgement is a joint function of task properties and cognitive properties" (Hammond, 1996, p. 83).

The cognitive continuum theory is based on three premises. First, reasoning, decision making and problem solving can be seen on a continuum with intuition on one end and analysis at the other end. Second, whether the problem solving approach is more intuitive or analytical will be based to a large part on the perception of the person completing the task. Lastly, to achieve the best task performance, the problem solving approach must match cognitive properties and requirements (Custers, 2013). It is believed experienced clinicians will combine different strategies when hypothesizing about a patient's problem (Pinnock & Welch, 2013; Elstein et al., 1990).

Situated cognition theory was also used to study the clinical reasoning process. Situated cognition theory looks at how learning and knowledge are a dynamic process and are affected by the interactions within each situation (McBee et al., 2015). The theory describes the complex interactions occurring between physician and patients and how these interactions are an important part of the variance needing to be measured (Durning et al., 2011). Hence, the outcome of a patient and physician interaction is not

just dependent on the physician's knowledge, but a complicated process where knowledge and context of the situation are both important factors (McBee et al., 2015).

Theories Used To Research Clinical Reasoning

The next section will present a brief summary of how the different health care professions used theories to research the clinical reasoning process. The theoretical perspectives used in nursing research on clinical reasoning included information processing theory and decision analysis theory. (Fonteyn & Ritter, 2008; Taylor, 2000). Early theoretical research of clinical reasoning in nursing and medicine were similar or in some cases identical. Both professions utilized mainly information processing theory and decisional analysis theory in early research on clinical reasoning.

Researchers used a qualitative methodology to clarify the perceptions of practicing nurse's clinical reasoning skills used a convenience sample of 520 registered nurses enrolled in a BSN program. The Clinical Decision Making in Nursing Scale was used to measure the student's perception of their clinical reasoning skills. The results showed that these nurses had a positive view of their clinical reasoning and problem solving skills, there by supporting that experience is a critical factor in developing strong reasoning and decision making skills. However, the findings indicated there was some difference in the students' perceived clinical reasoning skills and those actually seen in practice (Byrnes & West, 2000).

Information processing theory focuses on the reasoning process of experts in a particular field when solving a problem. The professional generates a hypothesis and collects data to prove or disprove the hypothesis (Jones, 1988). Proponents of

information processing theory contends there are limits to human processing and memory storage. The limits will affect the clinician's ability to recall information and thus the individual's problem solving ability (Taylor, 2000).

Decisional analysis theory research used the two general models of: Bayes Theorem and Brunswick's Lens model. (Taylor, 2000). Bayes theorem is a mathematically based theory using probability to "determine the likelihood of meaning of clinical data" (Fonteyn & Ritter, 2008, p. 236). Bayes theorem focuses on the hypothesis changing or being based on revised or new clinical data. The use of decision trees and computer programs are seen as useful tools in the theory. Brunswick's lens model is a probability theory that focuses on the relationship between the person and environment and how it affects a judgment situation (Fonteyn & Ritter, 2008).

The primary theories of clinical reasoning reported in medicine on clinical reasoning include: information processing, problem solving, and decision making theory. Research on the use of information processing theory in medicine studied how subjects stored and processed information, similar to a computer (Durning et al., 2013; Elstein & Schwarz, 2002).

An example of information processing theory in medicine is the dual processing theory of clinical reasoning. The research focused on a physician's reasoning, using two systems for clinical reasoning, analytical and non-analytical or intuitive systems (Bolton, 2015; Custers, 2013; Croskerry, 2009; Pinnock & Welch, 2013). Analytical systems were characterized as slower and consciously controlled systems using deduction which is the "application of rules to general cases" (Bolton, 2015, p. 486). A non-analytical system, used for pattern recognition, is described as a fast and unconsciously controlled

system. The non-analytical system is thought to be used by expert physicians as it is assumed they maintain a highly organized memory system. The intuitive, non-analytical approach of reasoning is dependent on previous experience and uses pattern recognition at an unconscious level. The analytical system is believed to be used by expert physicians when there is uncertainty regarding a patient diagnosis (Durning, et al., 2012; Pinnock & Welch, 2013).

The research into problem solving initially examined the reasoning process of expert physicians. Researchers studied how a problem was structured, and defined how a diagnostic hypothesis was generated by a physician (Elstein & Schwarz, 2002). Decision making theory incorporated Baye's Theorem, as previously described, as the foundation, and looked at decision making "as a process of uncertainty, updating an opinion with imperfect information" (Schwartz & Elstein, 2008, p. 227).

The research of the clinical reasoning process in physical therapy is similar to medicine in using a problem solving approach to better understand how the clinical reasoning process is used, developed and evaluated. The physiotherapist generates a hypothesis and looks at other factors that influence the patient's health such as the meaning of an illness and/or disability has to the lives of patients. The characteristics of the model include: cue acquisition, hypothesis generation, cue interpretation and hypothesis evaluation (Gilland, 2014, p. 64). Researchers found the hypothetico-deductive model was used extensively by novice clinicians, but experts only used the process when confronted by a new or more challenging case (Doody, et al., 2002). Clinicians in physical therapy utilize two different types of knowledge in the clinical reasoning process, propositional and non-propositional. Propositional knowledge refers

to theoretical knowledge. Non propositional knowledge refers to experience based knowledge (Higgs, Jones, & Tichen, 2008

The study of the clinical reasoning process in occupational therapy has been influenced to a large degree by medical research and scientific inquiry such as the information processing approach (Chapparo & Ranka, 2008; Fleming, 1991). As clinical reasoning is seen as a social interaction, elements of attitude-behavior theory have also been used to research the concept in occupational therapy. Therapists have to include not only the patient's physical problems but also determine "the meaning of the disability for the person in his or her life" (Mattingly & Fleming, 1994, p. 12).

Phases of the Clinical Reasoning Process

The next section will detail identification and development of the phases of the clinical reasoning process used in the study. During the literature review, phases of the clinical reasoning process emerged as a framework for clinical reasoning and the current study. Descriptions of clinical reasoning, including definitions and characteristics and studies of clinical reasoning contributed to identification of the phases of clinical reasoning (Elstein et al., 1990; Funkesson, et al., 2007; Payton, 1985; Scanlan & Hancock, 2010; Smyrni & Nikopoulos, 2007). The next section will summarize a few of the above studies outlining the different phases identified in the clinical reasoning process.

Funkesson et al. (2006), studied the clinical reasoning process of eleven nurses' planning care to prevent pressure ulcers using a written case study. The reasoning process nurses use while making decisions about a patient situation has been identified as

critical thinking, reflective reasoning etc. In medicine and other related domains it is called clinical reasoning. The researcher's utilized a qualitative design employing the Think-Aloud technique, protocol analysis and qualitative content analysis. Researchers found the nurses reasoned using assessing, planning, implementation and evaluation phases, aligned with the nursing process.

Scanlon and Hancock (2010), completed a pilot study to determine if including a structure framework to an online discussion class would enhance the quality of occupational therapy student's clinical reasoning process in online discussions. The students clinical reasoning abilities were assessed two ways. First the student's discussion postings were evaluated "different cognitive elements of clinical reasoning" (p. 403). Second the students evaluated their clinical reasoning skills by completing the Self-Assessment of Clinical Reflection and Reasoning tool. The students received directions regarding the requirements, expectations and received the designated framework for the online discussions. The students were divided into small similar groups and each student participated in the discussions in two roles, main student and peer. For each discussion, the students were expected to work through the elements of the clinical reasoning process. The clinical reasoning process was divided into three phases, phase one was assessment, phase two was intervention planning and phase three was evaluation. The three phases reflect the clinical reasoning process in occupational therapy. Researchers found the addition of the framework decreased the amount of basic elements of critical thinking and increased the amount of the evaluation elements of the clinical reasoning process in the discussion postings. The student's evaluation of their clinical reasoning skills showed significant changes over time.

Smyrini and Nikopoulos (2006) researched the incorporation of a new clinical reasoning model, the Analysis model, utilized by healthcare professionals, the experimental group, would compare with the established clinical reasoning model of the professionals individual profession, the control group, in caring for patients suffering from stroke or Trans Ischemic Attack (TIA). The Analysis Model was seen as a process of self-reflection. The Analysis Model includes the following steps; 1) gather data, 2) identify the type and degree of the problem, 3) identify risk adjusted outcomes, 4) identify treatment and goals, 5) develop plan and specific interventions, 6) identify specific treatments and expected length of treatment, 7) initiate therapy and supervise progress, 8) develop discharge plans and outcomes, 9) transition to patients real life, 10) monitor patients progress at home with referrals as identified.

Literature from each of the four health professions contained references to the phases of the clinical reasoning process and provided a foundation for the final five phases used in the current research (Elstein et al., 1990; May & Newman, 1980; Payton, 1985). The five phases of the clinical reasoning process identified from the literature are: *problem presentation, problem assessment, problem analysis, problem hypothesis and treatment, and problem evaluation and reflection*. Each phase is discussed below and includes a short description of the phase including the varied clinical reasoning elements for each phase, derived from the in-depth literature review.

Following the phase descriptions is a summary of several of the studies that facilitated the identification of these five phases. Although the phases appear linear in nature, the clinical reasoning process entails a cyclic process where the practitioner may

go back and forth between phases (Funkesson et al., 2007; Hunter, et al., 2012). See Appendix A for the elements of each phase and element sources.

Problem Presentation Phase

The *problem presentation phase* was defined as the time when the provider begins to suspect there is a real or impending problem with the patient or the patient is referred to the provider. The concepts identified for the phase from the literature include: cue acquisition, identify cues, attend to cues, abstraction, generic interview, context, source of symptom dysfunction, pattern recognition, information perception and interpretation, mental representation, recognizing a problem, problem identification, problem formation, categorization, define, referral, tacit/intuitive knowledge, intuition, initial hypothesis/hypothesis, predictive reasoning and OT diagnosis (Andersson et al., 2012; Audetat, et al., 2013; Benner & Tanner, 1987; Braude, 2012; Carr, 2004; Carrier, 2013; Charlin, 2012; Elstein et al., 1990; Elstein & Schwarz, 2002; Eva, 2004; Faucher, 2012; Fernando et al., 2013; Fontyn & Grobe, 1993; Gilland, 2014; Holdar,2013; Greenwood, 1995; Jefford et al., 2015; Jenson 1999; Jones, 1988; Jones, 1992; Jones et al., 2008; Kuiper, 2013; Lapkin, et al., 2010; Leicht & Dickerson, 2001; Marcum, 2012; Mattingly, 1991; McMillin, 2010; Patel & Groen 1986; Pinnock & Welch, 2013; Rivett, 1997; Scanlan & Hancock, 2010; Schell, 2003; Schmidt et al, 1990; Simmons et al., 2003; Strong et al 1995; Tanner, 2006; Vertue & Haig 2008). The above listed concepts describe the health care professionals possible thought processes and actions when identifying a patient problem.

The next section will summarize some of the research studies identifying the elements of the problem presentation phase. Benner and Tanner in 1987 studied intuition

in nursing judgment. Twenty-one nurses, identified as being experts by peers, were interviewed and observed in daily practice. The interview transcripts and observation data showed numerous examples of the nurses "intuitive judgment". The interviews and observations also provided examples of six of Dreyfus and Dreyfus aspects of intuitive judgement, including "pattern recognition, similarity recognition, common sense understanding, skilled know-how, sense of salience and deliberative rationality" (p. 23). The identification of intuition and pattern recognition by expert nurses support the consensus of the content expert's choice to retain these elements in the problem presentation phase.

Doody and McAteer (2002) investigated the clinical reasoning process of ten experts and ten novice physical therapists. The therapists were observed and audiotaped as they examined and treated a real patient. The results showed that both groups of therapists utilized the hypothetico-deductive model of clinical reasoning. However, the expert therapist's clinical reasoning process continued to evaluate the hypotheses, pattern recognition, and link treatment closely to a prior evaluated hypothesis. The novice therapist demonstrated a similar clinical reasoning process except for pattern recognition and had errors in reasoning. After the hypothesis generation the novice had trouble evaluating cues and the hypothesis. The researcher's findings coincided with the elements retained in the problem presentation phase of pattern recognition, recognizing a problem.

Faucher et al. (2012) completed a study to compare expert and competent level optometrist's clinical reasoning processes. The optometrists each performed a complete optometric examination on preselected patients. Results of the study showed the optometrists engaged many clinical reasoning processes throughout the examination to

include patient centeredness, planning, investigative process, analysis reflection and mental representation. The optometrists rapidly came to a mental representation of the patient's clinical situation. Pattern recognition was also seen as the optometrists quickly recognized the signs and symptoms of the patient's condition. The initial mental representation was modified in response to any additional information the optometrist received. The identification of mental representation and pattern recognition support the expert's retention of these elements in the problem presentation phase.

Researchers used a phenomenological approach to study a therapist with 10 years of experience working in a plastic surgery clinic to discover how the therapist's individual interactions affected clinical reasoning skills. Semi-structured interviews and observation of treatment sessions were used to gather data. The data analysis revolved around the following three themes identified in the analysis: "the informant's perception of responsibility, power and control; therapeutic relationships; and "swampy lowlands" (Crabtree & Lyons, 1997, p. 59). Schon, (1987) created the term "swampy" lowlands as a metaphor in the problem solving process. The term was meant as a way to describe the difference between the "hard ground" where theory is easily applied in solve problems, and the unclear problems, "swampy lowlands", that are difficult to solve with the application of a theory. The results indicated that the therapist's clinical reasoning skills exhibited a range of reasoning skills as identified in the literature. At times these skills worked well when used together and at times they were in conflict. The results confirmed the belief that the concept of clinical reasoning is a convoluted process (Crabtree, & Lyons, 1997).

Problem Assessment Phase

The *problem assessment phase* emerged as the time when the provider begins to collect data about the patient problem. The elements in the phase identified from the literature were collect cues, data collection, examines, investigate, cue acquisition, organizes knowledge, cue logic, judging the value, pattern recognition, mnemonic, draw on past experiences, evaluation, intention, goals, intervention, setting priorities, referral question, pattern confirmation, abduction, causal models/schema, propositional/causal networks, hypothesis generation, plans/planning, contributing factors, multiple hypothesis, examining data (Audetat, 2013; Banning, 2007; Barrows et al, 1982; Barrows & Feltovich, 1987; Cappelletti, 2014; Carrier, 2013; Doody & McAteer, 2002; Elstein et al., 1990; Faucher et al., 2012; Fernando et al, 2013; Fleming, 1991; Fonteyn & Ritter, 2008; Fowler, 1997; Funkesson et al, 2006; Gilland, 2014; Greenwood & King, 1995; Holder et al, 2013; Jensen & Givens, 1999; Jones, 1992; Jones et al., 2008; Kuiper, 2009 Lapkin et al.,2010; Leicht & Dickerson, 2001; Rivett & Higgs, 1997; Schell, 2003; Scanlon, 2010; Schmidt et al, 1990; Simmons et al., 2003; Strong et al 1995; Unsworth 2001; Vertue & Haig). The elements in the problem assessment phase describe the actions taken by the health care professional to begin collecting data to determine the patient's problem.

Unsworth, (2001), used a combined qualitative and quantitative approach to study the variances in the clinical reasoning skills of three experts and two novice occupational therapists. The study utilized video and audio recordings of a treatment session with patients in a rehabilitation setting. Each therapist then met with the investigator and

shared remarks on each session and a rationale for their reasoning. The quantitative results indicated the experts possessed a larger capacity to "reason interactively and conditionally than novices" (p. 172). Qualitative results indicated the experts were more confident in their idea presentation and flow of ideas. Experts "drew on past experiences when planning and executing therapy" (Unsworth, 2001 p 171). The experts were also more in tune to the patients and were better able to adapt the therapeutic activities than novices (Unsworth, 2001). The study highlights the fact that expert health care professionals use past experiences when assessing and collecting data to ascertain a patient's problem.

Taylor (2000) evaluated the cognitive processes used by experienced nurses during a patient assessment to answer the following research questions, what information do experienced nurses concentrate on while reasoning, what information is linked together in relationships, and what types of strategies do experience nurse's use when thinking? The framework used was information processing and the participants were asked to think aloud as they completed their assessments. The researchers found nurses reorganized their assessment information around concepts and linked them together. The most frequently used concepts were plan, rationale, status, test, treatment and value (Taylor, 2000). The study identified how experienced nurse link concepts together to organize the information when assessing a patient.

Simmons et al, (2003) investigated the reasoning strategies used by experienced nurses as they evaluated patient assessment findings using the think-aloud method. The most common concepts identified include, "amount, care provider, condition, day, time, date, device, diagnosis, event, family, frequency, location, missing clinical data, patient,

plan, rationale, status, test, treatment and value" (p.709). Statements intended to identify the connection of the concepts and facilitate the clinical reasoning process were, "anticipative (relationships of action and looking forward), causal (relationships of cause and effect), declarative (relationships of stating facts), and evaluative (relationships of judging significance)" (p 709). The above study highlighted how experienced nurses use casual models and connect concepts to expedite the clinical reasoning process

Problem Analysis Phase

The *problem analysis phase* was described as the time when the provider is assimilating data and information to arrive at a conclusion about the patient problem. The elements in the phase include critical thinking, context formulation, illness scripts, deduction, searching for information, organization of information, pattern matching, data gathering, processing information, consider patient situation, analyze and reflect, cue interpretation, providing relationships/explanations, hypothesizing, framing, hypothesis testing, intervention planning, problem reformulation, precautions /contraindications to treatment, evolving concept, drawing conclusion, analyze data (Anderson et al., 2012; Audetat, 2013; Barrows & Feltovich, 1987; Carr, 2004; Carrier, 2013; Faucher et al., 2012; Fernando et al, 2013; Fontyn & Grobe, 1993; Elstein et al,. 1990; Elstein & Schwarz, 2002; Fonteyn & Ritter, 2008; Fowler, 1997; Jefford et al., 2015; Jensen, 1999; Jones,1992; Jones et al., 2008; Gilland, 2014; Holdar, 2013; Greenwood & King, 1995; Kassirer, 2010; Kuiper, 2013; Kuipers & Grice, 2009; Marcum 2012; Rivette & Higgs 1997; Rogers & Holm, 1991; Scanlan, 2010; Schmidt et al, 1990; Simmons et al., 2003; Strong et al 1995; Vertue & Haig, 2008). The elements in the *problem analysis phase*

describe the different actions and thought processes the provider will take to evaluate the data gathered to determine the patient problem.

Shafaroodi et al. (2014) examined twelve experienced occupational therapists from various practice areas to discover the concepts affecting their clinical decision making process, using semi structured interviews. The research questions were, "how do you begin with a new client, and what factors influence your decision making during your work with clients?" (Shafaroodi et al., 2014 p. 3). Analysis of data identified three main themes, each with sub themes. The first theme was sociocultural conditions with the subthemes of client beliefs, therapist values and beliefs, and social attitudes related to disability. The second theme was "individual attributions with sub-themes of client attributions; and therapist attributions". The last theme was "the workplace environment with subthemes of knowledge of managers of rehabilitation services, working in an inter-professional team, and clinical facilities and resources" (Shafaroodi et al., 2014 p. 3). The themes identified in the study accentuate the importance of considering the patient situation when planning treatment.

Fonteyn and Grobe (1993) used a case study describing a critically ill patient to determine nurses' reasoning processes and problem solving strategies. The Think Aloud Method was used to gain knowledge about how these experts reason and solve problems. Concepts most often verbalized by the critical care nurses were action, amount, problem, sign, time, treatment and value. The major reasoning processes were study, conclude, choose, explain and were used as a way of organizing patient information. The nurses made sense of the information by forming relationships between different concepts, but were very selective about the information identified as important to the patient situation.

The main heuristic identified for these nurses was pattern matching and the use of predictive reasoning. The elements identified in the study concur with the elements in the problem analysis phase of organizing and processing information.

Greenwood and King (1995) utilized the Think Aloud Method to explore the difference in novice and expert orthopedic nurses clinical reasoning processes. Results showed the experts and novice nurses used mutual concepts in their reasoning. The expert nurses utilized more tactics to manipulate the presented information than novice nurses. The concepts identified were collect information, review information, interpret information, relate information and diagnose. The study results highlight how expert nurses are able to organize and manipulate the data to come to a conclusion about a patient problem. The elements identified in the study support the retained elements in the *problem analysis phase*.

Problem Hypothesis and Treatment Phase

The *problem hypothesis and treatment phase* is the time when the provider develops a hypothesis driven by the data analysis and initiates treatment for the problem. The elements in the phase are problem hypothesis, generate hypothesis, forming relationships, reflective comparison, draw conclusions, information into clusters or categories, ID problems, diagnostic test comparison, causal models, deduction, hypothesis testing, intervention, problem solution, proposing action, establish goals, take action, consider patient situation, management diagnostic management and decision (Andersson et al., 2012; Audetat, 2013; Banning, 2007; Carr, 2004; Carrier, 2010; Kassirer, 2010; Faucher et al., 2012; Fernando et al, 2013; Fleming, 1991;

Fontyn & Grobe, 1993; Fonteyn & Ritter; Fowler, 1997; Funkesson et al, 2006; Jefford et al., 2015; Jones et al., 2008; Jones, 1992; Marcum 2012; Jensen & Givens, 1999; Kuiper 2013; Kuipers & Grice, 2009; Rivett & Higgs, 1997; Schmidt et al, 1990; Smyrni & Nikopoulos, 2006; Strong et al 1995; Vertue & Haig, 2008). The elements retained for the phase describe the cognitive process the provider use to develop a hypothesis and treatment plan.

Kuipers and Grice (2009), used Person Construct theory to determine how a protocol would guide occupational therapists clinical reasoning skills in the rehabilitation of patients with upper limb problems. A purposeful sample consisted of thirteen novice therapists with three months to four years of experience, and eight experienced occupational therapists with experience ranging between nine and thirty years. Data was collected using repertory grid interviews to discuss the following elements: "initial perceptions about a client, making sense of assessment finding, identifying and framing upper limb problems and making treatment decisions" (p. 419). Results showed novice therapists demonstrated a significant change in their clinical organization post protocol to more closely imitate expert reasoning. "Therapy tasks encompassing assessment, treatment and goal setting" was the novice's way of structuring their reasoning". However, the novices also incorporated a "therapy framework to build their assessment and in developing clinical goals and planning treatment (p. 422). Post protocol, expert therapists changed their reasoning emphasis, to include arranging their clinical reasoning using the patient perspective and therapist/client collaboration. The experts also considered factors affecting the clinical reasoning process such as "client goal and contexts related factors (p. 422). The elements identified in the study describe how the

participants transformed the emphasis of their clinical reasoning skills to include the patient's perspective of the disability and align with the elements retained in the problem hypothesis phase of establish goals and consider the patient situation.

Ramezani-Badr (2002) examined the reasoning strategies and criteria used for clinical decision making by 14 Iranian critical care nurses. Content analysis revealed six main themes. Three themes of reasoning included intuition, recognizing similar situations and hypothesis testing. Three other themes regarding decision making were patients' risk-benefits, organization necessities and information sources. Study results showed when nurses use hypothesis testing they consider one or all of the criteria of risk benefit, organization and other sources of information. The study findings support the retained elements in the problem hypothesis and treatment phase of hypothesis testing and consider the patient situation.

Gilland (2014) examined the difference between first-year and third-year physiotherapy students' patterns of reasoning using a clinical case scenario and the think-aloud technique. The students evaluated and designed a treatment plan for the simulated patient. The student's hypotheses and assessments were coded using the international Classification of Functioning Disability and Health. The results showed the first year students reasoning process focused on the body's anatomical structures while the third year students focused on medical diagnosis. For the treatment plan, third year students included more attention to the patient as an individual than first year students. The findings of the study emphasized how the expert therapists considered the patient situation when planning treatment.

Problem Evaluation and Reflection Phase

The last phase is the *problem evaluation and reflection phase* and is defined as the time when the provider looks back at the assumptions, hypothesis and the treatment plan to determine if the problem has been alleviated or resolved. The elements in the phase are case formulation, making predictions, drawing conclusion, evaluate, hypothesis evaluation summary, reflect on process, prototype case reasoning, reflection, prognosis, reassessment (Andersson et al., 2012; Carrier, 2013; Doody & McAteer, 2002; Fleming, 1991; Fonteyn & Ritter, 2008; Fowler, 1997; Gilland, 2014; Jones, 1992; Kuiper, 2013; Leicht & Dickerson, 2001; Murphey 2004; Rivett & Higgs, 1997; Rogers & Holm, 1991; Scanlon, 2010; Simmons, 2003; Smyrni & Nikopoulos, 2006; Vertue & Haig, 2008). The concepts retained in the evaluation and reflection phase describe the actions a provider takes when evaluating and reflecting on the treatment plan to determine the effectiveness of the treatment plan.

Researchers studied thirty-three first semester nursing students to determine if reflection and articulation would enhance the development of clinical reasoning skills. The researchers wanted to determine if there was a difference in clinical reasoning measured by the ability to assess and analyze patient information, or by assessment of knowledge alone. Students in the treatment group were trained to use focused reflection and articulation to enable association between clinical rotation and lecture material. The students demonstrating better clinical reasoning skills used more articulation and focused reflection and found to be more engaged in abstract learning and self-regulated in their

learning (Murphey, 2004). The elements identified in the study support retained elements of reflect on process and reflection.

Hicks-Russell, et al. (2013), tested the use of the SAFETY template to provide senior baccalaureate nursing students in a pediatric rotation with the experience of practicing complex decision making. The template intended to aid the students in developing or improving their clinical reasoning skills, and used the framework of the nursing process as a starting point to include a system specific assessment. The students then chose appropriate roommates for their patient, delegated tasks and identified inaccurate orders. Next the students evaluated real and expected patient responses. The final phase covered the legal and ethical challenges of nursing care. Upon completion of the process the students used reflection and developed case studies based on the SAFETY template to present to their peers. The students' case study presentations were concise and accurately described the priority concerns for the patient. The study findings emphasized the retained elements of reflection, evaluation and making predictions. The identified concepts mirror the retained elements in the problem evaluation and reflections phase of reflection, evaluate, and making predictions.

Synthesis of the Literature

Researchers in the health care professions have studied clinical reasoning to determine how health care professionals identify and treat patient problems. For many years it was thought the human mind could be trained in logical thinking and problems solving skills. Learning to play chess was encouraged for school children to help develop these skills. It was also presumed professionals such as physicians had trained their minds in problem solving and thinking skills. However, eventually it was determined the

skills of problem solving and thinking were not developed separately from a professions domain knowledge and training but alongside that knowledge (Boshuizen & Schmidt, 2008).

The medical professions were innovators in the research on the concept of clinical reasoning. The body of research evolved due to concerns of medical educators wanting to teach medical problem solving to undergraduate medical students. The concept of clinical reasoning, as the name has evolved, has been the topic of much debate and research over the last four to five decades. (Bordage & Lemieux, 1991; Durning, et al., 2013; Loftus, 2012; Neufeld et al., 1981; Norman, 2005). Terms synonymous with clinical reasoning in the medical research literature include problem solving, diagnostic reasoning, therapeutic reasoning, clinical decision making, clinical judgment and medical problem solving (Durning et al., 2013; Norman, 2005; Marcum, 2012; Thomson et al., 2010). The theoretical influences in the research of clinical reasoning include problem solving and decision making. During the 1960's research on clinical reasoning in medicine centered on the information processing approach using the Think Aloud Technique and observation of physicians examining simulated patients. The publication of *Medical Problem Solving* by Elstein et al. (1978) in the mid-1970s was influential in the research of clinical reasoning as the authors and researchers of *Medical Problem Solving* were the first to correlate the problems with diagnostic reasoning to the theory of problem solving. Another important influence from the publication were "both successful and unsuccessful diagnosticians employed a process of generating and testing diagnostic hypotheses" (p. 9). Another influential researcher during the time was DeGroot who used verbal protocol to observe chess masters planning moves. He was the

first researcher to compare the differences between master and weak chess players. These findings influenced not only the research on clinical reasoning in medicine but in all the health care professions.

The nursing profession began researching clinical reasoning in the 1980's. Research on clinical reasoning followed the path of medical research using theoretical perspectives such as information processing and decision analysis theory. An influential publication was the study by Benner and Tanner (1987) which examined the processes of intuition and intuitive judgment of experienced nurse's. Benner and Tanners findings helped launch the nursing research on clinical reasoning. Future research in nursing needs to be directed at how clinical reasoning affects a patient's outcomes. Research should be directed away from the laboratory and simulation lab to the clinical setting to enable researchers to determine the affect clinical reasoning has on patient care.

The early research of clinical reasoning in physical therapy followed the hypothetico-deductive model of medical research. The pattern of research continued until the mid-1990 when research moved from the laboratory to the practice site. Clinical reasoning research began to emphasize perspectives of the provider and patient utilizing narrative reasoning which looks to understand the patient's stories. Narrative reasoning involves understanding the patient's experiences related to the disability, beliefs, feelings and health behaviors (Edwards et al., 2004 p.2).

Clinical reasoning research in occupational therapy began in the 1960's. Clinical reasoning was referred to as treatment planning, an evaluative process of clinical thinking and problem solving (Chapparo & Ranka (2008). In 1960 an early model of clinical reasoning evolved based on a procedural reasoning process. The model was described as

the treatment plan based on data acquired through data collecting, observation, testing, interviews and case histories. In 1970 the model evolved into the "assessment and treatment planning part of the occupational therapy process (p. 267). Day (1973) generated a decision making model which included "problem identification, cause identification, treatment principle or assumption selection, activity selection and goal identification" (p. 267). In 1983 it was suggested clinical reasoning education be integrated into the occupational therapy curriculum. Current research on clinical reasoning has been influenced by the expansions of the occupational therapists roles and goals of occupational therapy.

One major factor identified in the literature review is the amount of research each profession has completed on the clinical reasoning process. The literature reviews of these studies refer to other health care professions research either as background data or in support of the current study's findings. The implications for research and gaps identified in the majority of health care professions research is the need to identify how to teach, develop and assess the clinical reasoning process in practicing healthcare professionals and students alike. But in order to fill the gaps in the research on clinical reasoning, identification of the essential elements of the clinical reasoning process must come first. Without identification and consensus of the essential elements of the clinical reasoning process there would be no foundation on which to develop, teach and assess the clinical reasoning process.

Chapter Two presented a synopsis of the research literature surrounding the clinical reasoning process in the different health care professions and identified a gap in the literature, no consensus on the essential elements of the clinical reasoning process.

The research on clinical reasoning has been restricted to the individual professions, although each profession has a similar interest in finding ways to teach, develop and evaluate the process. There were several trends and similarities identified in the literature review. Research completed in the different professions used almost identical methodological approaches and obtained very similar results in studying the clinical reasoning process. Similar terminology was used to describe the different concepts associated with the process.

Although there is no consensus on the essential elements of clinical reasoning, similar concepts and terms were identified. There were also phases identified in the clinical reasoning process among the health professions. Similar terms and phases from the literature review were used as a basis for development of the Delphi survey. Chapter Three will present the methodology of the study and elaborate and summarize how similar terms in each profession were combined and placed in categories to build the Delphi Study survey used to identify the essential elements in the clinical reasoning process.

CHAPTER THREE: RESEARCH DESIGN

INTRODUCTION

The Delphi method was developed in the late 1950s by the Rand Corporation as a method for gaining consensus from content experts (Gordon, 2009). Chapter Three includes a description of the methodology used in a Delphi study to identify the essential elements in the clinical reasoning process of health care professionals. Chapter Three presents the research purpose and question, the method used to complete an in-depth literature review necessary to construct the survey, the population, sample, instrumentation, data collection and plan for data analysis.

RESEARCH PURPOSE

The purpose of the research study was to identify the essential elements of the clinical reasoning process. The research question was: What are the essential elements of the clinical reasoning process of health care professionals?

RESEARCH DESIGN

The study used a Delphi methodology to seek consensus from content experts on the essential elements of the clinical reasoning process in health care professionals. The Delphi method was developed as a way of obtaining and synthesizing opinions or judgments of content experts on a particular topic for a particular area of application. In 1944, General Henry Arnold "commissioned a report for the US Air Force on the future technological capabilities that might be used by the military" (Keeney et al., 2011 p 2). After failed attempts to answer the questions about technological capabilities using customary forecasting methods such as theoretical approaches, the Delphi method began to emerge. The use of focus groups to forecast events pinpointed three problems:

domineering personalities, noise and group pressure. The initial use of the Delphi method used experts to express their opinion of the probability, frequency and intensity of possible military attacks. The process of seeking the expert opinion was repeated until consensus was achieved (Keeney, et al., 2011). The Delphi method was developed on the presumption that "individual statistical predictions were stronger than unstructured face to face group predictions" (Keeney et al, 2011 p 2). The name for the Delphi method was drawn from the "Greek Oracle" at Delphi where necromancers foretold the future (Gordon, 2009).

The Delphi method is defined as "a multi-staged survey which attempts ultimately to achieve consensus on an important issue" (Keeney et al., 2011 p 3). The Delphi Method is also defined as, "an iterative process designed to combine expert opinion into group consensus" (Keeney et al., 2011 p 4). The intent of the method is to eliminate the extraneous factors affecting a face to face meeting of experts and instead have the focus remain on the topic at hand (Gordon, 2009)

Researchers have successfully used the Delphi method for obtaining consensus in a wide array of topics. According to Gordon (2009) a review of the Scopas data base in September 2008, identified health sciences as the leading field of study using the Delphi method. Examples of topics researched using the Delphi method included: asthma indicators, health education, nursing education, physiotherapy and severe acute respiratory distress syndrome. According to Keeney et al. (2011), researchers in nursing have used the Delphi method for two main reasons, to set priorities such as nursing research priorities and to gain consensus.

In the classic Delphi Methodology researchers present a questionnaire developed about a particular topic in a specific field of concentration. The presentation of the questionnaire can be completed in person or via email. The questionnaire is presented to the content experts in the specific field as the first round. After all the surveys have been

completed, the data is summarized and a new questionnaire is developed. The modifications to surveys are continued after each round until consensus is reached or no new modifications are necessary to the questionnaire (Keeney et al., 2011). The number of rounds will vary from two to four, although three rounds are usually sufficient (Hsu & Sandford, 2007). Delphi studies are not intended to achieve generalizable results, but reflect the opinion of the particular content expert group. A variation on the traditional Delphi is the use of online communication for the study. The main advantage to the online version is faster communication and ease of use for the experts.

To initiate a Delphi study, a researcher identifies content experts in the particular field the researcher is studying. An important point in the selection of content experts is the experts cannot merely have knowledge of the research topic. Simply knowing about the concept does not make one an expert (Kenney et al., 2011). There should be documentation of the expert's in-depth understanding of the research topic. The experts in a Delphi study must be "fully described" so there will be no questions about their judgments (Kennedy, 2004). There is some debate on the number of experts necessary to to successfully implement a Delphi study. The recommendations for the number of experts range from ten to fifteen. (Yousuf, 2007). Ludwig (1997), recommends the number of experts is "generally determined by the number required to constitute a representative pooling of judgments" (p. 52). Researchers ask the selected experts to record an opinion about a particular aspect of a topic or concept throughout several rounds

SAMPLE

For the current study, twenty-two potential experts were identified through the literature review on clinical reasoning in health care professions. Once the potential experts were identified, the principal investigator investigated each potential expert to

identify current position, published research studies, articles and presentations on the concept of clinical reasoning as a way of verifying each individual as an expert. Twenty of the potential twenty-two experts qualified for participation using the following criteria. The inclusion criteria for the experts were: 1) be a contributor to the understanding of the concept of clinical reasoning relating to a health care profession, either as an individual or group author of three or more publications via print or internet sources, 2) be a willing participant in all rounds of the Delphi Study, and 3) be able to read, write and speak English. The twenty potential experts were contacted via email and an in-depth explanation of the project was given, (see Appendix B). The email outlined the research study purpose, research question, methodology including the use of Survey Monkey®, and the consent procedures. Ten of the twenty identified content experts accepted the invitation to participate in the research study. The invited group of experts was a heterogeneous grouping from the professions of nursing, medicine, physical therapy and occupational therapy.

Once an expert agreed to participate, the principal investigator sent an email to the expert via Survey Monkey® with instructions for the survey process and the survey link for round one. Instructions for the survey included a statement indicating the completion of the first round by the subject indicated consent to participate. Additionally, in the first round, the survey included a request for demographic data from each participant citing the expert's profession, practice or clinical specialty, age, sex, ethnicity, education level. The initial sample for the study included ten content experts in clinical reasoning. Once the demographic data were received from the experts, ID numbers were assigned to each expert and a codebook was created.

SETTING

Once round one of the survey, including the demographic data, was designed, examined for errors and approved by the primary investigator and the dissertation

committee chair, the study began. The Delphi study used Survey Monkey(R) for ease of communication and to allow content experts to complete the surveys in their choice of environments.

ETHICAL CONSIDERATIONS

The proposal for the study was submitted to the Institutional Review Board of the University of Texas Medical Branch. The IRB granted the principal investigator exempt status for the study.

Potential Risks for the Experts

The identified risks for the participant were as follows: 1) if identities were known, there could be pressure from other experts to direct the study results in the direction of a particular expert's wishes and 2) there could also be potential stress due to the time required to complete the survey.

Potential Benefits for the Experts

The potential benefit for the experts was from participation in the study of a concept at the forefront of health care professions education and practice. The experts would know they had contributed to identification of the essential elements of clinical reasoning, a first step toward ensuring health care professions students and practicing professional have adequate clinical reasoning skills. Clinical reasoning skills are fundamental to ensuring safe and quality patient care.

Procedures to Maintain Confidentiality

The identification of individual experts was protected by assigning ID numbers known only to the primary investigator and kept in a master codebook. The codebook identification key was kept separate from the surveys. No digital images or photographs were taken of the experts. As the purpose of the study was to achieve a group consensus, no individual responses for the survey were obtained and only aggregate data was reported from Survey Monkey®. The information obtained by the primary investigator to verify expert status was kept with the master codebook so the experts could not be identified by their job title, place of employment or publications. The identification codes, including any electronic survey results, were maintained in the principal investigator's office in a locked cabinet. Although Survey Monkey is not anonymous, the experts' identifications and survey responses and print-outs were kept confidential as described above.

SURVEY DEVELOPMENT

Literature to Support Survey

A general literature review, discussed in chapter two, was completed to research the concept of clinical reasoning. However, an additional in-depth literature review was necessary to develop the survey for round one of the Delphi study. Since the outcome of the research was intended for use in health care professions and health care professions education, adult populations were used as a limiting factor in the literature search.

Combining Elements

A review of the retrieved literature continued until identification of elements in the clinical reasoning process reached saturation. Ninety-eight different elements were

identified (see Appendix B). Once the saturation point was reached and no new elements were identified, similar elements were combined and one label was used to represent several elements. For example, one combination of elements was associated with "identifying" a problem and "recognizing" a problem. The terms "identifying" and "recognizing" were deemed similar enough to combine the two elements into one element of the clinical reasoning process, "recognizing a problem." Another example was "analyze data" and "data analysis". The terms were combined into one term "analyze data". The combination of elements was necessary because it is unlikely the experts could distinguish between 98 elements in round one of the Delphi survey. There were also unique elements identified in the literature such as "prototype case reasoning. The unique elements may only have applied to one profession but were left unchanged and included in the survey for the experts to ascertain whether they were an essential element. Appendix C contains the list of the final elements for round one of the Delphi survey.

DATA COLLECTION PROCESS

The questionnaire for the Delphi study was created in Survey Monkey(R) and the link was forwarded to each content expert via email. There was a fourteen-day time period allotted for the experts to respond to the questionnaire. The experts received emails reminding them to complete the survey weekly during the fourteen-day period. Experts who had not completed the survey after 14 days were sent a reminder via Survey Monkey ® to complete the survey. A total of two reminders to complete the survey were sent to the experts during each round. When all of the experts had completed the survey, or it was determined by the principal investigator to close the study round, the questionnaire responses were retrieved and tabulated to develop the survey for the next round. The process continued for two rounds, at which time it was deemed no further

element elimination would occur. The minimum number of expected responses for a round of the survey would be three quarters (3/4) of the experts (Hsu & Sandford, 2007).

The first round survey consisted of a request for content experts' demographic data and a review of the elements identified from the literature listed under each phase of clinical reasoning process (see Appendix C). The content experts were asked to evaluate each of the identified elements in each phase and rate the elements on a four point Likert scale. The goal was to determine the level of agreement with the stated elements being essential to the clinical reasoning process. The decision to use a four-point scale was to ensure the expert indicated his or her opinion instead of a neutral rating. There was a comment section provided with each question in the first round only to allow the experts to add any additional elements they deemed essential to the clinical reasoning process or to comment on the elements presented.

After the first round, the responses were tabulated to determine which elements to retain and which to discard for round two. The elements were retained if the mean for the element was 3.25 or higher (Hsu & Sandford, 2007). Survey Monkey® provided the mean for each of the elements in both rounds. The retained elements became the survey for round two and the experts were asked to rate the elements using the same process as for round one.

After the second round the responses were tabulated to determine which elements to keep and which to discard using the same criteria as outlined for round one. The elements retained became the final list of essential elements in the clinical reasoning process in health care professionals. Once the final round was completed, the data were exported from Survey Monkey® and entered into SPSS for statistical analysis.

SUBJECT SAFETY AND DATA MONITORING

The principal investigator collected the results of the Delphi study for each round and used the data to revise the essential elements of clinical reasoning survey for the next round. A new questionnaire was developed after the first round with the modified essential elements and sent via Survey Monkey to the content experts to evaluate. When it was deemed no further revision to the essential elements could be achieved the study was completed and a final list of the phases and essential elements of clinical reasoning was developed.

DELPHI SURVEY: THE FIRST ROUND

The survey for the first round was worded: "Using the provided Likert scale, indicate your level of agreement that the following elements are *essential* to the clinical reasoning process in health care professionals". Use the comment section to add elements not listed that you feel are *essential* elements. Appendix D contains a copy of the survey for round one.

DELPHI SURVEY: THE SECOND ROUND

The survey for the second round was worded: "Using the provided Likert scale, indicate your level of agreement that the following elements are *essential* to the clinical reasoning process in health care professionals". The study finished after two rounds when it was deemed by the principal investigator in consultation with her committee no further elimination of the elements would be accomplished. Appendix C contains a copy of the survey for round two.

DATA ANALYSIS PROCEDURES

Obtaining expert consensus on a particular topic has been addressed in several research studies. Miller (2006), recommended an 80% agreement among experts would be acceptable for consensus. He stated experts' votes would need to fall within two categories on a seven point Likert scale. Another recommendation for consensus was a 70% agreement determined by a rating of three or higher on a four point Likert scale, with a weighted average of 3.25 or higher (Hsu & Sandford, 2007). Hsu & Sandford (2007), in a third study, recommended a percentage measure of agreement would be inadequate, however in some studies the mean is acceptable. A more reliable measure would be the stability of the expert's response in successive measures

The recommended statistics for a Delphi study are measures of central tendency, mean, median and mode as well as levels of dispersion such as standard deviation and inter-quartile ranges (Hsu & Sandford, 2007). There is some disagreement concerning the use of the mean and generally the median and mode are preferred. However, when using a Likert format scale the median is the recommended measure although, there are cases where the mean is practical (Hsu & Sandford, 2007). The data were analyzed both by Survey Monkey® which supplied the mean, and via SPSS. Demographic data obtained from the experts were analyzed using Survey Monkey®.

Demographic data were obtained from all the experts and included gender, age, ethnicity, highest level of education, and professional field. Results provided by Survey Monkey® for each round included copies of the round question, a list of elements, the mean response for each element, number of responses and date the round was completed. Information provided about the experts such as email and name were kept with the master codebook and secured in the principal investigator's office in a locked cabinet. The quantitative data were entered into the SPSS program for analysis. Completed analysis

included descriptive statistics including mean, median, mode, standard deviation and percentages of agreement as well as a histogram showing the frequencies of the data.

SUMMARY

Chapter Three presented the methodology for the research study including how the in-depth literature review was utilized to identify elements and phases of the clinical reasoning process as a basis for the initial surveys for the Delphi study. Chapter Three also included a discussion of the Delphi method's uses, benefits and limitations as well as how the Delphi method was utilized in the present study. The process for selecting content experts was outlined, as well as the methods for maintaining confidentially of the identity and responses of the content experts. Chapter Three also outlined the study procedures including development and methods analysis of rounds one and two as well as a description of how the data were analyzed upon study completion. Chapter Four will contain the data obtained from the Delphi study and the analysis of the data used to arrive at a description of the essential elements of the clinical reasoning process.

Chapter 4: Data Analysis

INTRODUCTION

As described in chapter one, the intent of the research study was to identify the essential elements in the clinical reasoning process of health care professions using a Delphi Study. The chapter provides a summary of the demographic descriptors for the content experts who participated in the Delphi study and the results of the Delphi Study of the essential elements of clinical reasoning.

SAMPLE DESCRIPTION

Twenty content experts in clinical reasoning were invited to participate in the Delphi Study to identify the essential elements in the clinical reasoning process. The experts were from the professions of nursing, medicine, physical therapy and occupational therapy. Of the twenty identified experts, ten agreed to participate. At the completion of round one, eight experts responded to the survey, two experts decided not to participate in additional rounds. The data from the eight content experts are summarized below.

DEMOGRAPHIC DATA

The demographic data of the experts included gender, age, ethnicity, highest level of education, and professional field. Table one summarizes the responses to the demographic data questions in the survey. Although both male and female experts were invited to participate, the final gender breakdown of experts consisted of 75% female and 25% male, with an age range from 35 to 74 years old and a mean age of 54 years. All the experts were Caucasian and held a doctoral degree as their highest level of education.

The experts' professions included a fairly even distribution from nursing, medicine and physical therapy, but only one from occupational therapy with the largest number of experts from physical therapy

Table 1. Demographic Data of Experts

Demographic Data	Variables	Frequency
Gender	Female	6 (75 %)
	Male	2 (25 %)
Age in Years	35 to 44	2 (25%)
	45 to 54	1 (12.50%)
	55 to 64	4 (50%)
	65 to 74	1 (12.50%)
Ethnicity	White/Caucasian	8 (100%)
Highest Level of Education	Doctorate	8 (100 %)
Professional Field	Nursing	2 (25%)
	Medicine	2 (25%)
	Physical Therapy	3 (37.50%)
	Occupational Therapy	1 (12.50%)

RESEARCH QUESTION

The research question for the study was: "What are the essential elements of the clinical reasoning process of health care professionals?" The proposed essential elements identified from the literature were grouped as similar terms for the first round of the Delphi study (Appendix C). The choice to use the majority of the elements identified

in the literature was to prevent potential bias from the primary investigator by preselecting the elements to be included in the survey. The goal of the study was to seek consensus on the essential elements of clinical reasoning from content experts in the identified fields of health care. The principal investigator identified five phases of the clinical reasoning process and each phase contained the essential elements relevant to a given phase. The phases identified were: problem presentation, problem assessment, problem analysis, problem hypothesis and treatment and problem evaluation and reflection.

ROUND ONE

In the first round, the expert panel consisted of ten clinical reasoning experts. In July 2015, 89 elements distributed among the five phases of clinical reasoning comprised the first round of the Delphi study. Eight out of ten experts had responded by September 2015 resulting in an 80% response rate. Expert consensus, as indicated by a mean of 3.25 or greater provided by analysis from Survey Monkey ®, was achieved on 71 of the initial 90 clinical reasoning elements ranked on a four point Likert scale (Hsu and Sanford, 2007). The data for round one were reviewed and elements were retained for round two if the expert's level of agreement was a mean of 3.25 or better. One expert in round one completed the survey for only the first three phases of the clinical reasoning process survey. The data were included in the totals for the elements in the three phases in which the expert participated. Specific analysis completed to determine percentage of agreement included frequencies and percent agreement for each element.

The elements for round one were retained or eliminated based on the mean of 3.25, as described above. In round one, for the 71 elements retained, the range of agreement level was as follows. In the *problem presentation phase*, there was an 87% to 100% agreement level for retention of the eleven elements in the phase. When

considering the valid percent for retained elements, an example would be the element of cue acquisition. The percent of experts who *strongly agreed* to retain the element was 77.8% and the percent of experts who *agreed* to retain the element was 11.1% for a total agreement of 88.9%. Another example would be the element of pattern recognition. The percent of experts who *strongly agreed* to retain the element was 72.5% and the percent who *agreed* to retain the element was 25% for a total agreement of 97.5%. The percentage of agreement for all the elements retained in the *problem presentation phase* was 87% and above. An example of an eliminated element would be the element hypothesis with a percentage of agreement to retain of 62%. For the elements retained in the problem presentation phase, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 9) from .353 to 1.01. The mode ranged from 3.0 to 4.0 and the median from 3.0to 4.0 for the retained elements.

In the *problem assessment phase*, there was an 87% to 100% agreement to retain fourteen elements in the phase. The percentage of agreement for all the elements retained in the *problem assessment phase* was over 87%. For the elements retained in the *problem assessment phase*, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 8) of .353 to .744. The mode ranged from 3.0 to 4.0 and the median ranged from 3.0 to 4.0. for the retained elements.

In the *problem analysis phase*, there was an agreement of 87% to 100% to retain the eighteen elements in the phase. The percentage of agreement for all the elements retained in the *problem analysis phase* was 87% and above. For the elements retained in the mean ranged from 3.38 to 3.75, with a standard deviation (n = 8) of .462 to .755. The mode ranged from 3.0 to 4.0 and the median from 3.0 to 4.0 for the elements retained.

In the *problem hypotheses and treatment phase*, there was an 87% to 100% agreement to retain the seventeen elements. The percentage of agreement for all the elements retained in the *problem hypothesis and treatment phase* was 85% or higher. For

the elements retained in the *problem hypotheses and treatment phase*, the mean ranged from 3.29 to 3.86, with a standard deviation (n = 8) range from .377 to .786. The mode ranged from 3.0 to 4.0 for the retained elements. For the elements retained the median ranged from 3.0 to 4.0.

In the *problem evaluation and reflection phase*, there was an 87% to 100% agreement to retain all ten elements in that phase. The percentage of agreement for all the elements retained in the phase was 85% and above. For the elements retained in the *problem evaluation and reflection phase*, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 8) of .377 to .786. The mode ranged from 3.0 to 4.0 for the retained elements. For the elements retained the median ranged from 3.0 to 4.0. Table Two summarizes each element, by phases, in round one - listing the mean, median, mode and standard deviation for each element.

The phases with the most element elimination for round one were, the *problem presentation phase* which began with nineteen elements and eight elements were eliminated, the *problem assessment phase* which began with nineteen elements and five elements were eliminated, and the *problem analysis phase* which began with twenty-two elements and had four elements eliminated. Appendix E included data for the complete frequency and percent agreement for each element in round one.

Table 2: Round One Analysis of Elements of Clinical Reasoning

Phase	Element	Mean	Retained	Median	Mode	SD
Problem	Cue Acquisition	3.56	Y	4.0	4.0	1.01
Presentation	Identify Cues	3.88	Y	4.0	4.0	.353
Phase	Attend to Cues	3.38	Y	4.0	4.0	1.06
(N = 9)	Abstraction	3.22	N	3.0	4.0	.833
	Generic Interview	2.88	N	3.0	3.0	.640
	Pattern Recognition	3.50	Y	4.0	4.0	.755
	Mental Representation	3.88	Y	4.0	4.0	.353
	Recognizing a Problem	3.75	Y	4.0	4.0	.462
	Problem Identification	3.50	Y	3.5	3.0	.534
	Categorization	3.43	Y	3.0	3.0	.534
	Referral	2.13	N	2.0	2.0	.640
	Tacit/Intuitive Knowledge	3.22	N	3.0	4.0	.833
	Intuition	3.25	Y	3.0	3.0	.707
	Hypothesis	2.88	N	3.0	4.0	1.12
	Predictive Reasoning	2.63	N	2.5	2.0	1.06
	Initial Diagnosis	2.88	N	3.0	3.0	.991
	Source of Symptom/Dysfunction	2.88	N	3.0	2.0	.834
	Information Perception	3.50	Y	3.5	3.5	.534
	Information Interpretation	3.75	Y	4.0	4.0	.462
Problem	Data Collection	3.63	Y	4.0	4.0	.517
Assessment	Examining Data	3.88	Y	4.0	4.0	.353
Phase	Investigate	3.75	Y	4.0	4.0	.462

Phase	Element	Mean	Retained	Median	Mode	SD
Problem Assessment Phase (N = 8)	Cue Acquisition	3.50	Y	3.5	3.0	.534
	Organize Knowledge	3.63	Y	4.0	4.0	.744
	Cue Logic	3.12	N	3.0	3.0	.834
	Judging the Value	3.63	Y	4.0	4.0	.755
	Pattern Recognition	3.75	Y	4.0	4.0	.707
	Mnemonic	2.25	N	2.0	2.0	.462
	Draw on Past Experiences	3.50	Y	4.0	4.0	.755
	Evaluation	3.38	Y	3.5	4.0	.744
	Intention/Goals/Intervention	3.00	N	3.0	2.0	.925
	Setting Priorities	3.50	Y	3.5	3.0	.534
	Referral Question	2.75	N	3.0	3.0	.462
	Pattern Confirmation	3.43	Y	3.0	3.0	.534
	Causal Models	3.25	Y	3.0	3.0	.462
	Contributing Factors	3.50	Y	3.5	3.0	.534
	Initial Concept	3.50	Y	3.5	3.5	.534
	Hypotheses Generation	3.13	N	3.0	3.0	.834
Problem Analysis Phase (N = 8)	Critical Thinking	3.63	Y	4.0	4.0	.744
	Context Formulation	3.75	Y	4.0	4.0	.462
	Illness Script	3.50	Y	4.0	4.0	.755
	Analyze Data	3.75	Y	4.0	4.0	.462
	Deduction	3.63	Y	4.0	4.0	.517
	Searching for Information	2.75	N	3.0	3.0	.462
	Organization of Information	3.63	Y	4.0	4.0	.744
	Pattern Matching	3.75	Y	4.0	4.0	.462
	Data Gathering	2.75	N	3.0	3.0	.462

Phase	Element	Mean	Retained	Median	Mode	SD
Problem Analysis Phase	Processing Information	3.75	Y	4.0	4.0	.707
	Consider Patient Situation	3.63	Y	4.0	4.0	.517
	Reflect	3.50	Y	3.5	3.5	.534
	Contraindications to Treatment	3.12	N	3.0	3.0	.640
	Evolving Concepts	3.38	Y	3.5	4.0	.744
	Providing Relationships/Explanations	3.38	Y	3.5	4.0	.744
	Hypothesizing	3.38	Y	3.5	4.0	.744
	Framing	3.63	Y	4.0	4.0	.517
	Drawing conclusions	3.38	Y	3.0	3.0	.517
	Hypothesis Testing	3.50	Y	3.5	3.0	.534
	Intervention Planning	2.88	N	3.0	2.0	.834
	Problem Formulation	3.63	Y	4.0	4.0	.517
	Cue Interpretation	3.63	Y	4.0	4.0	.517
Problem Hypothesizing Treatment Phase (n = 8)	Management	3.71	Y	4.0	4.0	.487
	Decision	3.57	Y	4.0	4.0	.786
	Diagnostic Management	3.86	Y	4.0	4.0	.377
	Diagnostic Test Comparison	3.43	Y	3.0	3.0	.534
	Generating Hypothesis	3.57	Y	4.0	4.0	.534
	Forming Relationships Between Cues	3.71	Y	4.0	4.0	.487
	Reflective Comparison	3.57	Y	4.0	4.0	.534
	Drawing Conclusions	3.43	Y	4.0	4.0	.786
	Information into Cluster/Categories	3.57	Y	4.0	4.0	.534
	ID Problems	2.57`	N	3.0	3.0	.534
	Intervention	3.57	Y	4.0	4.0	.534
	Causal Models	3.29	Y	3.0	3.0	.487

Phase	Element	Mean	Retained	Median	Mode	SD
Problem	Deduction	3.29	Y	3.0	3.0	.487
Hypothesis	Hypothesis Testing	3.57	Y	4.0	4.0	.534
Treatment	Intervention	3.86	Y	4.0	4.0	.377
	Problem Solution	3.86	Y	4.0	4.0	.377
	Proposing Action	3.86	Y	4.0	4.0	.377
	Establish Goals	3.71	Y	4.0	4.0	.487
	Take Action	3.57	Y	4.0	4.0	.534
Problem	Making Predictions	3.71	Y	4.0	4.0	.487
Evaluation	Drawing Conclusions	3.86	Y	4.0	4.0	.377
Reflection Phase	Evaluate	3.43	Y	4.0	4.0	.786
(n = 8)	Hypothesis Evaluation	3.57	Y	4.0	4.0	.786
	Summary	3.57	Y	4.0	4.0	.534
	Reflect on Process	3.43	Y	4.0	4.0	.786
	Prototype Case Reasoning	3.71	Y	4.0	4.0	.487
	Prognosis	3.29	Y	3.0	3.0	.755
	Reassessment	3.57	Y	4.0	4.0	.534
	Case Formulation	3.43	Y	3.0	3.0	.534

Expert Comments: Round One

Round one also provided a section where the experts could comment on each of the phases and elements in the survey. For the *problem presentation phase* the following comments were recorded.

"This feels a bit focused on the "patient"...problem presentation often includes contextual info as well based on setting and key caregivers/family etc".

"Mental representation is vague." "It assumes a cognitive psychology approach. There are other forms of mental representation besides cognitivism that might be more useful".

"Narrative medicine would use narrative master plots as mental representations but these are quite different from the mental representation of cognitivism".

"There is a danger with this kind of question that the wording of the question already assumes what the answer is".

"Add the element cognitive critical thinking skills"

The first expert comment in the problem presentation phases demonstrated one of the differences seen in the application of the clinical reasoning process. The context of the patient situation may be given more emphasis in one profession compared to another profession. The second expert comment demonstrates how the same term can have different connotations in different health care professions. The third comment was a suggestion to add "cognitive critical thinking skills" to the elements. Cognitive critical thinking skills in the literature encompass an entire process and describes many of the elements listed in the different phases of the study, therefore it was not added to the elements.

For the *problem assessment phase* the following comments were stated, "Some of these questions are difficult to answer as they oversimplify complex processes. For example, what does it mean to evaluate?" "Add the element metacognition". The first expert comment in the *problem assessment phase* demonstrated once again how similar terms can have a different

meaning to different health care professions. The second comment was a suggestion to add "metacognition" to the element list. Metacognition by definition is the analysis of one's own learning or thinking ("Metacognition," 2016), therefore it was not added to the elements list. The elements listed in the phase define the metacognitive process such as drawing on past experiences, judging the value, and evaluation.

For the *problem analysis phase,* the following comments was recorded.

"I believe that some of these vary based on the profession. For instance, some professions would more fully define problem before trying interventions or hypothesis testing. In occupational therapy, since the focus is on performance prediction, there is a lot more "back and forth" between problem identification/analysis and trials to test interventions or more fully identify salient factors affecting performance."

The only comment for the problem analysis phase described how the clinical reasoning process can be slightly different in each of the professions. As stated previously, the phases identified do not occur in a linear process but can and do involve a back and forth approach when deliberating on a patient problem, therefore there were no additions to the survey based on the comment.

There were no comments for the *problem hypothesis and treatment* nor the *problem evaluation and reflection phases.* A table containing the expert's comments, themes and revision proposals for future studies are included in Appendix X.

ROUND TWO

For round two, the survey was sent to the eight remaining experts. There were 71 elements in five phases sent in September 2015 and seven out of eight experts responded by

December 2015 resulting in an 87.5% response rate. Expert consensus was achieved on 59 of the 70 round two clinical reasoning elements for an overall agreement level of 84.5%.

In the *problem presentation phase*, there was an 87% to 100% agreement for retention of the nine elements in the phase. The percentage of agreement for all the elements retained in the *problem presentation phase* was 84% and above. For the elements retained in the phase, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 7) from .534 to .786. The mode ranged from 3.0 to 4.0 for the retained elements and the median ranged from 3.0 to 4.0.

In the *problem assessment phase*, there was an 87% to 100% level of agreement to retain the ten elements in that phase. The percentage of agreement for all the elements retained in the *problem assessment phase* was over 84%, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 7) range from .487 to .755. The mode ranged from 3.0 to 4.0 for the retained elements and the median ranged from 3.0 to 4.0.

In the *problem analysis phase*, there was an of 87% to 100% level of agreement to retain the fifteen elements in that phase. The percentage of agreement for all the elements retained in the *problem analysis phase* was 85% and above. For the elements retained in the *problem analysis phase*, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 7) range from .377 to 1.13. The mode ranged from 3.0 to 4.0 and the median ranged from 3.0 to 4.0.

In the *problem hypotheses and treatment phase*, there was an 87% to 100% agreement to retain the fifteen elements. The percentage of agreement for all the elements retained in the *problem hypothesis and treatment phase* was over 85%. For the elements retained in the problem presentation phase, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 7) range from .377 to .786. The mode ranged from 3.0 to 4.0 for the retained elements and the median ranged from 3.0 to 4.0.

In the *problem evaluation and reflection phase*, there was a 71% to 100% agreement to retain the nine elements in that phase. The percentage of agreement for all the elements retained

in the *problem evaluation and reflection phase* was 85% and above. For the elements retained in the problem presentation phase, the mean ranged from 3.25 to 3.88, with a standard deviation (n = 7) range from .377 to .786. The mode and the median both ranged from 3.0 to 4.0 for the retained elements. These high levels of agreement over the two rounds indicate stability in the expert's responses as a group.

The data for round two was reviewed and elements were retained for the final list of essential elements in the clinical reasoning process if the mean was 3.25 or greater. Table Three summarizes each element, by phases, in round two, listing the mean, median, mode and standard deviation for each element.

Table 3 Round Two Analysis of Elements of Clinical Reasoning

Phase	Element	Mean	Retained	Median	Mode	SD
Problem Presentation Phase (n = 7)	Cue Acquisition	3.71	Y	4.0	4.0	.755
	Identify Cues	3.71	Y	4.0	4.0	.755
	Attend to Cues	3.57	Y	4.0	4.0	.786
	Pattern Recognition	3.29	Y	3.0	3.0	.755
	Mental Representation	3.29	Y	3.0	3.0	.755
	Recognizing a Problem	3.57	Y	4.0	4.0	.534
	Problem Identification	3.29	Y	3.0	3.0	.755
	Categorization	2.88	N	3.0	3.0	.690
	Intuition	3.14	N	3.0	3.0	.377
	Information Perception	3.43	Y	3.0	3.0	.534
	Information Interpretation	3.57	Y	4.0	4.0	.786
Problem Assessment Phase (n = 7)	Data Collection	4.00	Y	4.0	4.0	.000
	Examining Data	3.71	Y	4.0	4.0	.487
	Investigate	3.71	Y	4.0	4.0	.487
	Cue Acquisition	3.57	Y	4.0	4.0	.534
	Organize Knowledge	3.71	Y	4.0	4.0	.487
	Judging the Value	3.71	Y	4.0	4.0	.487
	Pattern Recognition	3.71	Y	4.0	4.0	.487
	Draw on Past Experiences	3.57	Y	4.0	4.0	.534
	Evaluation	3.43	Y	3.0	3.0	.534
	Setting Priorities	3.14	N	3.0	3.0	.690
	Pattern Confirmation	3.00	N	3.0	3.0	.577
	Causal Models	3.00	N	3.0	3.0	1.00
	Contributing Factors	3.29	Y	3.0	3.0	.755
	Initial Concept	3.00	N	3.0	3.0	.816

Phase	Element	Mean	Retained	Median	Mode	SD
Problem	Critical Thinking	4.00	Y	4.0	4.0	.000
Analysis	Context Formulation	3.86	Y	4.0	4.0	.377
Phase	Illness Script	3.14	N	3.0	3.0	.377
	Analyze Data	3.86	Y	4.0	4.0	.377
	Deduction	3.57	Y	4.0	4.0	.534
	Organization of Information	3.71	Y	4.0	4.0	.487
	Pattern Matching	3.57	Y	4.0	4.0	.534
	Processing Information	3.71	Y	4.0	4.0	.487
	Consider Patient Situation	3.86	Y	4.0	4.0	.377
	Reflect	3.71	Y	4.0	4.0	.487
	Evolving Concepts	3.43	Y	3.0	3.0	.534
	Providing Relationships/Explanations	3.43	Y	4.0	4.0	.786
	Hypothesizing	3.71	Y	4.0	4.0	.487
	Framing	3.57	Y	4.0	4.0	.534
	Drawing conclusions	3.00	N	3.0	3.0	1.00
	Hypothesis Testing	3.14	N	3.0	3.0	1.06
	Problem Formulation	3.43	Y	4.0	4.0	1.13
	Cue Interpretation	3.57	Y	4.0	4.0	.534
Problem	Management	3.71	Y	4.0	4.0	.487
Hypothesis &	Decision	3.57	Y	4.0	4.0	.786
Treatment Phase	Diagnostic Management	3.57	Y	4.0	4.0	.534
(n = 7)	Diagnostic Test Comparison	3.14	N	3.0	3.0	.377
	Generating Hypothesis	3.43	Y	3.0	3.0	.534
	Forming Relationships Between Cues	3.71	Y	4.0	4.0	.487
	Reflective Comparison	3.57	Y	4.0	4.0	.534
	Drawing Conclusions	3.43	Y	4.0	4.0	1.13
	Information into Cluster/Categories	3.57	Y	4.0	4.0	.534
	Intervention	3.71	Y	4.0	4.0	.487
	Causal Models	3.29	Y	3.0	3.0	.387
	Deduction	3.57	Y	4.0	4.0	.534

Phase	Element	Mean	Retained	Median	Mode	SD
Problem Hypothesis & Treatment Phase	Hypothesis Testing	3.86	Y	4.0	4.0	.377
	Intervention	3.71	Y	4.0	4.0	.487
	Problem Solution	3.14	N	3.0	3.0	1.06
	Proposing Action	3.57	Y	4.0	4.0	.534
	Establish Goals	3.57	Y	4.0	4.0	.534
	Take Action	3.86	Y	4.0	4.0	.377
Problem Evaluation Reflection Phase (n = 7)	Making Predictions	3.43	Y	3.0	3.0	.534
	Drawing Conclusions	3.57	Y	4.0	4.0	.534
	Evaluate	3.57	Y	4.0	4.0	.534
	Hypothesis Evaluation	3.86	Y	4.0	4.0	.377
	Summary	3.86	Y	4.0	4.0	.377
	Reflect on Process	4.00	Y	4.0	4.0	.000
	Prototype Case Reasoning	3.43	Y	3.0	3.0	.534
	Prognosis	3.00	N	3.0	3.0	.816
	Reassessment	3.71	Y	4.0	4.0	.487
	Case Formulation	3.57	Y	4.0	4.0	.786

The phases with the most elements eliminated for round two were *the problem assessment phase* and *the problem analysis phase.* Initially there was fourteen elements in the *problem assessment phase* in round two, four elements were eliminated. The *problem analysis phase* contained eighteen elements at the beginning of round two, three elements were eliminated. Appendix F contains the frequency and percent agreement data for each element in round two.

The decision to stop the Delphi study after two rounds was based on several factors. First, the number of experts that initially agreed to participate was ten. By the end of round one, there were eight experts remaining. At the beginning of round two there were eight experts. By the end of round two there were seven experts remaining. Seven is the minimum recommended number of experts for a Delphi study. Secondly, according to the literature the dropout rate of experts increases with subsequent rounds due to time commitment and the repeated exposure to the same type of survey (Day & Bobeva, 2005; Hsu & Stanford, 2007). Thirdly, the number of elements at the beginning of round one was 90. Be the end of round two there were 60 elements remaining, a 34% decrease in the number of elements initially presented to the experts. The primary investigator felt further rounds would not produce significant changes in the final essential elements. After consultation with the Dissertation committee, the Delphi study was halted after two rounds

FINAL ELEMENTS

The aim of the study was to identify the essential elements in the clinical reasoning process used in the health care professions. Since the goal of the study was to seek a consensus of content experts as a group, the data were not analyzed by individual professions. In addition, with the small numbers from each profession, there would be a greater potential for loss of anonymity if responses were reported by profession. The goal of the study was accomplished by the use of a Delphi methodology and content experts in the field of clinical reasoning as

described above. Table Four outlines the final identified elements for the clinical reasoning process at the conclusion of the two study rounds.

Table 4: Final Essential Elements of Clinical Reasoning

Phase	Problem Presentation	Problem Assessment	Problem Analysis	Problem Hypothesis	Problem Evaluation
Elements	Cue Acquisition	Data Collection	Critical Thinking	Generate Hypothesis	Case Formulation
	Identify Cues	Examining Data	Context Formulation	Relationship bet. Cues	Making Predictions
	Attend to Cues	Investigate	Pattern Matching	Reflective Comparison	Drawing Conclusions
	Pattern Recognition	Cue Acquisition	Analyze Data	Drawing Conclusions	Evaluate
	Info Interpretation	Organize Knowledge	Deduction	Info into Clusters/	Hypothesis Evaluation
	Info Perception	Judging the Value	Organization of Info	categories	
	Mental Representation	Pattern Recognition	Processing Info	Establish Goals	Summary
	Recognizing a Problem	Draw on Past Exp	Consider Pt Situation	Proposing Action	Prototype Case Reasoning
	Problem Identification	Evaluation	Reflect	Reflect on Process	Reassessment
		Contributing Factors	Providing Relationships	Causal Models	Reflect on Process
			Explanations	Deduction	
			Hypothesizing	Hypotheses Testing	
			Framing	Intervention	
			Problem Formulation	Take Action	
			Cue Interpretation	Management	
			Evolving Concept	Decision	
				Diagnostic Mgmt	

SUMMARY

Chapter Four presented the data analysis for the study. The chapter included the demographic data for the content experts, as well as the number of elements present and eliminated in each round. Tables Two presents all the elements in round one including the mean, median, mode and standard deviation values for each element. Table Two also identifies which elements were retained and eliminated in round one. Table Three outlines all the elements in round two including the mean, median, mode and standard deviation values for each element. Table Three also lists which elements were retained and eliminated in round two in the Delphi study. Table Four identifies the list of final essential elements in the clinical reasoning process selected by content experts in the professions of nursing, medicine, physical therapy and occupational therapy in two rounds of the Delphi study. Chapter Five will present a summary of the major findings of the study, implications for practice, education and research, limitations and suggestions for future research

Chapter 5 Discussion of Results

Introduction

The previous chapters presented the concept of clinical reasoning including the background, history and significance of the clinical reasoning process in health care professions. Next a thorough literature review was presented encompassing a history of the research of the clinical reasoning process, review of research, interrelated concepts and the identification of the phases of clinical reasoning used in the study. Succeeding chapters described the Delphi Methodology and the study design. Next, the study results and statistical findings were explained. Chapter Five will include a discussion of the major findings of the study, study limitation, implications for practice and education, methodology assumptions and limitations, potential for future research and a summary.

Synthesis of Major Findings

The goal of the study was to identify the essential elements of the clinical reasoning process. Concepts identified in the literature were used to create surveys by which content experts could voice their opinion on whether the identified concepts were essential elements of the clinical reasoning process. One finding identified relates to the choice of elements retained by the experts. In the *problem presentation phase* of both rounds, the experts retained elements describing ways a health care professional identified a patient problem such as identify cues and pattern recognition. *In the problem assessment phase,* the retained elements focused on the process health care professionals

use to obtain data to determining a patient's problem. Retained elements in the *problem assessment phase* included data collection and contributing factors. In the *problem analysis phase,* experts selected elements at interpreting data used to detect the patient problem such as critical thinking and pattern matching. In the *problem hypothesis and treatment phase*, the experts selected elements such as draw conclusions and establish goals as essential to the needed to create a treatment plan for the identified patient problem. In the final phase, the *problem evaluation and treatment phase* the retained elements retained such as draw conclusions and summary described decisions made to determine if the course of action was successful in alleviating the patient's problem.

All of the elements retained, regardless of the phase, portray active thinking or physical actions rather than a passive activity. The theme for the elements retained is one of working to discover not only the patient's problem but also the best option to treat the problem. The elements are considered active because they portray the actions the providers takes to seek out information to identify and treat a patient's problem. The active element of reflection and evaluation not only allows the provider to evaluate the current treatment plan, but also enable the professional to enhance and improve his/her clinical reasoning skills. An example of a passive element would be the eliminated element referral. Referral does not depict an active process but passive as the patient is sent to the provider.

In round one of the Delphi study, the experts were given a comments section to additional elements of make general comments. The expert's comments were described and addressed in Chapter Four. The expert's comments are an example of the variation between the health care professions regarding some of the elements that may apply to one

profession. The comments and suggestions for additional elements will be utilized to make adjustments to future Delph studies.

An important finding was that the experts eliminated elements primarily from the first three phases. One reason for the finding may be related to the variability of the processes represented by the elements in the first three phases. For example, in the *problem presentation phase*, there are a variety of methods in which a patient problem is presented or identified. For the nursing profession, patients are admitted with a particular diagnosis. However, a nurse's responsibility is to attend to cues in order to recognize a problem developing in a patient. In medicine, patients seek out medical help for their problem by either making an appointment with a physicians or are assigned a physician by accessing the health care system. Physical therapy and occupational therapy have patients referred to them either in a hospital or outpatient settings. The last two phases, *problem hypothesis and treatment* and *problem evaluation and reflection* are more of a straightforward processes with less variability in each profession.

A third and major result of the current research findings is how the final essential elements actually create potential definitions of the phases of the clinical reasoning process. The creation of potential definitions of the phases of the clinical reasoning process, based on the final essential elements in each phase, create a source for future research to validate the definitions. Rather than a list of elements, the construction of definitions that can be researched and tested provides a foundation for more robust research to examine the clinical reasoning process within and across professions. Examples are described below of how the final essential elements of clinical reasoning are a beginning for understanding the phases that make up the clinical reasoning process.

In the *problem presentation phase*, the final essential elements create a foundation for the process a provider would use to identify a patient problem. The final essential elements in the *problem presentation phase* include cue acquisition, identify cues, attend to cues, pattern recognition, information interpretation and information perception, recognizing a problem and problem identification. A definition of the *problem presentation phase* using the above elements could read, *a cognitive process of identifying and recognizing a patient problem using cues and pattern recognition, as well as information interpretation and perception*. In the *problem assessment phase*, the final essential elements include data collection, examining data, investigate, cue acquisition, organize knowledge, judging the value, pattern recognition, draw on past experiences, evaluation and contributing factors. A definition of the *problem assessment phase* using the final essential elements could read, *a problem is assessed through an investigative process consisting of data collection, recognizing similar patterns, drawing on past experiences and identifying contributing factors*. In the *problem analysis phase*, the final essential elements include critical thinking, context formulation, pattern matching, analyze data, deduction, organization of information, processing information, consider patient situation, reflect, providing relationships, explanations, hypothesizing, framing, problem formulation, cue interpretation, evolving concept. A definition of the *problem analysis phase* based on the final essential elements could be, *using critical thinking the data are organized and analyzed to determine relationships between the data, cues, context, patterns, and the patient situation*

In the *problem hypothesis and treatment* phase the final essential elements include generate hypothesis, relationship between cues, reflective comparison, drawing

conclusions, information into clusters and categories, establish goals, proposing action, reflect on process, causal models, deduction, hypothesis testing, intervention, take action, management, decision, diagnostic management. A definition for the *problem hypothesis and treatment phase* using the final essential elements could be, *the act of organizing, analyzing and comparing data to determine relationships between clusters of data to establish goals and propose actions, interventions, and hypotheses.*

In the *problem evaluation and reflection phase*, the final essential elements include case formulation, making predictions, drawing conclusions, evaluate, hypothesis evaluation, summary, prototype case reasoning, reassessment and reflect on process. A definition of the *problem evaluation and reflection* phase using the final essential elements could be*, using reflection, hypotheses are generated, summarized, evaluated, reassessed and tested to establish goals, predict outcomes, and draw conclusions on the patient's response.*

A final important finding is the ability to reach consensus on the final essential elements across different health care professions. Rather than having separate beliefs about the key elements in the clinical reasoning process, the present research used multiple health care professions to determine essential elements included in the phases of the clinical reasoning process that can ultimately define clinical reasoning.

What these consensus conveys, is despite the differences in the emphases of the different professions, the professions agreed on elements of the clinical reasoning process. Consensus supports the idea that inter-professional research on the concept of clinical reasoning can be taken to the next level of researching the development of a clinical reasoning model for the health care professions. There has been a tremendous

amount of research completed on clinical reasoning in the last forty years. Harnessing the expertise from the different professions will no doubt facilitate the development of how to teach develop and assess the vital skill of clinical reasoning.

COMPARISON OF STUDY RESULTS TO THE LITERATURE

In comparing the identified elements to research studies examining the clinical reasoning process of expert health care professionals, the following parallels were found. Fonteyn and Grobe, (1993) studied how experienced critical care nurses plan care for a patient at risk. They identified a total of twenty concepts used by the experienced nurses. The most recurrent concepts included: action, amount, problem, sign, time treatment and value. In the list of final essential elements the concepts correlating to the study by Fonteyn and Grobe include: recognizing a problem, problem identification, judging the value, take action and intervention. The correlation of the final elements support the decision of the experts to retain the elements.

Crespo et al. (2004) compared the diagnostic reasoning processes of competent and expert dentists. The expert dentists displayed the following characteristics in the reasoning process: organization of ideas, identify key clinical findings, included patient context, ability to decide between important and non-important data, organization of ideas, and made reference to typical cases. The similar final elements in the clinical reasoning process include: organize knowledge, identify cues, pattern recognition and information interpretation. The study findings identify elements that expert dentists use. The elements identified in the study used by experts reinforce the choice to retain the listed elements.

Payton (2016) compared the clinical reasoning ten expert physical therapists with the problem solving skills of physicians. The concepts of the clinical reasoning process by the therapists that mirrored physicians included: problem list formation, information gathering, and treatment planning. Similar concepts in the final list of essential elements include, data collection, problem formulation, hypothesizing and intervention. The study identified that similar elements of clinical reasoning are demonstrated by physical therapists and physicians. The finding shows that despite the difference in the two professions there is similarities in the clinical reasoning process of both professions.

Strong, et al. (2016) researched the different views on clinical reasoning comparing expert and novice occupational therapists. The components of clinical reasoning considered most important by the expert therapist included: communication, data collection, knowledge of injury and illness, philosophical and ethical base, processing and interpreting information, patient expectation, set goals and treatment plan. In the list of the final essential elements, the comparable concepts include: information interpretation, information perception, data collection, consider patient, intervention and establish goals. The finding supports the elements of data collection, processing and interpreting information, set goals and treatment plan as essential elements in the clinical reasoning process.

The findings described above identified elements expert clinicians' use in the clinical reasoning process. The identified elements in the studies correlate to the list of final essential elements identified by the current study. It would be expected experts in a profession would utilize the essential elements of the clinical reasoning process and the findings further strengthen the experts choice of retained essential elements.

METHODOLOGY BENEFITS AND LIMITATIONS

The advantage of the Delphi study is the ability to objectively and anonymously explore the issues requiring expert opinion to gain a consensus about a particular facet of a particular topic. The weakness or problems that can occur include participant drop out, large amounts of time for multi-round studies, and the necessary time and attention to detail for the method to be successful (Yousuf, 2007). Other reasons cited for failure include organizing the Delphi structure to prohibit or inhibit an experts contributions of other perspectives, poor summarization techniques for developing questionnaires for succeeding rounds, failure to explore disagreements from participants thus limiting new data or creative responses from participants, and failure to recognize participants in the Delphi study are generously giving of their time and the lack of compensation (Yousuf, 2007).

Other issues include logistical issues such as internet access and organization firewalls which could prevent access to the survey questionnaire and could be a limiting factor for participation in the study. Failure by Delphi experts to answer all the questions in a survey can reduce responses and result in uneven reporting for individual questions. The current study was delivered and administered via Survey Monkey ® and there were no prompts or reminders to ensure the participants answered all the survey questions. There were partial expert responses in the results of the current study, a factor limiting thorough review of the elements.

STUDY LIMITATIONS

The limitations of the present study include a small sample size, as the recommended number of experts is 10 to 15 for a homogenous participant group (Hsu & Sandford, 2007). Another limitation is the decision to end the study after two rounds. However, as described in Chapter Four the decision to conclude the study after two rounds was based on several factors. The first factor was the decrease in the number of experts, which can affect the quality of the expert consensus (Hsu & Sandford, 2007). The number of experts declined from ten initial experts to eight in the first round and seven in the second round. The second factor was the 34% decrease in the number of elements by the second round indicated a likelihood of little further reduction in elements. Another limitation could be seen in the phases of the clinical reasoning process identified from the literature. The identified phases were not developed to assume the clinical reasoning process is linear in nature. The phases were a method for organizing the elements in a manner seen in the literature of the above mentioned professions.

IMPLICATIONS FOR PRACTICE

The consensus on the essential elements of clinical reasoning gained from the study has implications for practice, education and research. Practicing health care professionals can evaluate their clinical reasoning skills using the essential elements as the essential elements paint a clearer picture of what the clinical reasoning process entails. Health care professions administration can integrate the essential elements into appraisal instruments to evaluate the clinical reasoning skills of practicing health care

professionals. Staff development personnel can utilize the essential elements to develop continuing education programs to improve clinical reasoning skills of health care professionals.

Implications for Education

Improving clinical reasoning skills is an integral part of a health care professional's education. Health care professions educators can utilize the essential elements to develop skill competencies with the clinical reasoning elements embedded in the competency, thus helping health care students develop clinical reasoning in all levels of education. Educators can also develop interactive cases studies and simulations integrating the essential elements of clinical reasoning to ensure students graduate with beginning clinical reasoning skills. Clinical evaluation tools can be constructed identifying the essential elements required during clinical practice. The health care educator can reveal his/her clinical reasoning process by identifying the essential elements the educator used to come to a conclusion about a patient's problem. An evaluation tool can be developed to objectively assess the level of clinical reasoning of health care professions students at the different levels of progression in their program.

IMPLICATIONS FOR FURTHER RESEARCH

Future research needs to focus on expanding and refining the results of the current study. Suggestions include a repeat Delphi study including a larger sample of content experts not only to verify these elements, but to apply common definitions to the elements. An expansion of the study to larger samples within professions would allow consensus among more health care professionals as well as comparison between

professions. A Delphi study enhanced by interviews with select experts might also lead to additional understanding of the importance of the essential elements as well as the value to each profession. Simulation scenarios need to be created and researched, using the essential elements, to foster the development and enhancement of clinical reasoning skills. A final recommendation is research to develop and validate an evaluation tool, based on the final essential elements. Such a tool could be used to evaluate the progression of practicing health care professionals or students in enhancing or improving current clinical reasoning skills

CONCLUSIONS

The ultimate goal for the research study is to improve the clinical reasoning skills in health care professionals and to ensure the development of beginning clinical reasoning skills in health care professions students. The consensus achieved in the study across the different health care professions is a first step toward that goal. Clinical reasoning is an essential skill across all the health care professions. It is a holistic continuous assessment, based on the theories of reasoning and incorporates a variety of skills to provide safe, quality patient care. Achieving consensus on the essential elements of the clinical reasoning process is a crucial step towards better understanding improved teaching and better evaluation of the clinical reasoning skills of health care professionals and students alike. Each health care profession can utilize these essential elements as a foundation for the clinical reasoning process to develop and adapt the process to meet the needs of their individual profession while maintaining continuity with other professions.

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Appendix A: Clinical Reasoning Elements and Sources

Problem Presentation Phase	Medicine	Nursing	Physical Therapy	Occupational therapy	Source
Cue Acquisition	X	X		X	Schell, 2003; Leicht & Dickerson, 2001; Carrier, 2010; Jefford et al., 2015
Identify Cues / Cues	X	X	X		Audetat, et al., 2013; Gilland, 2014, Jones, 1988
Attend to Cues				X	Leicht & Dickerson, 2001
Abstraction	X				Fernando et al., 2013
Generic Interview	X				Vertue & Haig 2008
Context	X	X	X	X	Carrier, 2013 ;Elstein et al., 1990; Eva, 2004; Holdar,2013;Kuiper, 2013; Mattingly, 1991); Scanlan, 2010; Schmidt et al, 1990, Jones 1988
Source of Symptom / Dysfunction			X		Jones, 1992; Rivett, 1997
Pattern Recognition	X	X	X		Carrier, 2013;Elstein et al., 1990; Fontyn & Grobe, 1993 Leicht & Dickerson 2001; Jenson 1999; Patel & Groen 1986,; Schmidt et al, 1990; Simmons et al. 2003; May & Newman, 1979
Information Interpretation / Perception		X	X	X	Greenwood, 1995, Jones et al., 2008; Strong et al 1995
Mental Representation	X				Faucher, 2012; McMillin, 2010
Recognizing a Problem		X			Carr, 2004; Fontyn & Grobe, 1993
Problem Identification		X		X	Kuipers & Grice, 2009; Lapkin, et al., 2010; Leicht & Dickerson, 2001

Problem Formation	X			X	Carrier, 2013; McMillian, 2010; Vertue & Haig, 2008
Categorization	X		X		Elstein & Schwarz, 2002; Charlin, 2012; Jones, 1988
Tacit/Intuitive Knowledge	X				(Braude, 2012); Marcum2012
Intuition	X	X			Leicht & Dickerson, 2001; Pinnock & Welch, 2013; Tanner, 2006, Benner & Tanner, 1987
Initial Hypothesis / Hypothesis	X	X			Andersson et al., 2012; Audetat, et al., 2013; Charlin, 2012; Jones, 1988
Predictive Reasoning		X			Fontyn & Grobe, 1993
Occupational Therapy Diagnosis				X	Leicht & Dickerson, 2001;

Problem Assessment Phase	Medicine	Nursing	Physical Therapy	Occupational therapy	Source
Collect Cues		X	X		Gilland, 2014; Lapkin et al.2010, Hunter et al, 2012
Data Collection	X	X	X	X	Audetat, 2013; Leicht & Dickerson, 2001; Strong et al 1995; Greenwood & King, 1995; Vertue & Haig
Examines	X		X	X	Kuipers, 2009; Jensen & Givens, 1999
Investigate	X				
Cue Acquisition			X	X	Schell, 2003; Leicht & Dickerson, 2001; Carrier, 2010; Doody & McAteer, 2002
Organizes Knowledge	X			X	Scanlon, 2010
Cue Logic		X			Fowler, 1997
Judging the Value		X			Banning, 2007; Fowler, 1997; Funkesson et al, 2006
Pattern Recognition	X	X	X	X	Carrier, 2013; Elstein et al., 1989; Gilland, 2014; Leicht & Dickerson, 2001; Fleming, 1991; Fonteyn & Ritter, 2008
Mneumonic				X	Loftus & Higgs, 2008
Draw on Past Experiences		X		X	Cappelletti, 2014
Evaluation			X	X	Carrier, 2010; Jensen & Givens, 1999
Intention, Goals, Intervention			X	X	(Kuipers, 2009)
Setting Priorities		X			Fonteyn & Ritter , 2008
Referral Question	X				Vertue & Haig, 2008
Pattern Confirmation	X				Vertue & Haig, 2008
Abduction	X				Fernando et al, 2013
Causal Models/Schema	X				Schmidt et al, 1990
Propositional/Causal Networks	X				Schmidt et al, 1990
Hypothesis Generation	X	X	X		Audetat, 2013; Elstein etal 1990; Fontyn & Ritter, 2008;Gilland, 2014 ; Leicht & Dickerson, 2001; Jensen, 1999; Holder, 2013

Plans/Planning	X	X			Faucher et al., 2012; Simmons et al., 2003, Banning, 2007
Contributing Factors			X		Jones, 1992; Rivett, 1997
Initial Concept			X		Jones et al.,2008
Multiple Hypothesis	X		X		Barrows et al, 1982; Jones et al.,2008
Examining Data	X				Barrows & Feltovich, 1987

Problem Analysis Phase	Medicine	Nursing	Physical Therapy	Occupational therapy	Source
Critical Thinking	X	X	X		Fonteyn & Ritter, 2008 , Wainwright et al., 2011
Context Formulation	X				Kaisser, 2010
Illness Scripts	X				Jensen, 1999; Kuiper, 2013; Marcum 2012; Schmidt et al, 1990
Deduction	X				Fernando et al, 2013; Kuiper, 2013
Searching for Information		X			Fonteyn & Ritter, 2008
Organization of Information		X		X	Scanlan, 2010; Kuiper, 2013; Fontyn & Grobe, 1993
Pattern Matching	X	X	X		Elstein & Schwarz, 2002; Fontyn & Grobe, 1993; Jensen, 1999; Kuipers & Grice, 2009
Data Gathering	X	X			Barrows & Feltovich, 1987; Schmidt et al, 1990; Simmons et al., 2003
Processing Information		X			Greenwood & King, 1995
Consider patient Situation				X	Strong et al 1995; Carrier, 2013
Analyze and Reflect	X				Faucher et al., 2012
Cue Interpretation		X	X		Gilland, 2014, Jefford et al., 2015; Rogers & Holm, 1991
Providing Relationships / Explanations		X			Fontyn & Grobe, 1993; Simmons et al., 2003
Hypothesizing		X			Fowler, 1997; Kuiper, 2013; Anderson et al., 2012
Framing		X			Carr, 2004; Fowler, 1997
Hypothesis Testing			X	X	Jensen, 1999; Holdar, 2013; Audetat, 2013; Elstein et al,. 1990; Leicht & Dickerson, 2001
Intervention Planning				X	Strong et al 1995; Carrier, 2013

Problem Reformulation	X			X	Elstein & Schwarz, 2002
Precautions / Contraindications to Treatment			X		Jones,1992; Rivette1997
Evolving Concept			X		Jones et al., 2008
Drawing Conclusion		X			Anderson et al., 2012
Analyze data	X	X	X		Kuiper, 2013; Vertue & Haig, 2008; May & Newman, 1979

Problem Hypothesis and Treatment Phase	Medicine	Nursing	Physical Therapy	Occupational therapy	Source
Generate Hypothesis	X	X	X	X	Kaisser, 2010; Fonteyn & Ritter; Jones et al, 2008
Forming Relationships		X			Fontyn & Grobe, 1993; Banning, 2007
Reflective Comparison		X			Fowler, 1997
Draw Conclusions	X	X			Andersson et al., 2012; Fontyn & Grobe, 1993
Information into Clusters or Categories	X	X	X		Fontyn & Grobe, 1993; Jefford et al., 2015; Jones, 1988; Smyrni & Nikopoulos, 2006; Schmidt et al, 1990
ID Problems		X			Hunter et al., 2012
Causal Models	X				Schmidt et al, 1990; Vertue & Haig, 2008
Deduction	X	X			Fernando et al, 2013; Kuiper 2013; Marcum 2012
Hypothesis Testing		X	X	X	Elstein et al 1989, Fleming, 1991; Jefford et al., 2015
Intervention		X	X	X	Carr, 2004; Carrier, 2013; Jones et al., 2008; Jensen & Givens, 1999
Problem Solution			X	X	Jensen, 1999
Proposing Action		X			Anderson et al., 2012
Establish Goals	X	X		X	Fontyn & Grobe, 1993; Funkesson et al, 2006; Strong et al 1995; Smyrni & Nikopoulos, 2006, Hunter et al.,2012
Take Action		X			Andersson et al., 2012; Fontyn & Grobe, 1993; Funkesson et al, 2006
Consider Patient Situation		X	X		Fleming, 1991; Kuipers & Grice, 2009, Hunter et al., 2012

Management	X		X		Audetat, 2013; Faucher et al., 2012; Jones, 1992; Rivett & Higgs, 1997; Smyrni & Nikopoulos, 2006
Diagnostic Management			X		Jones et al., 2008
Decision			X		Rivett & Higgs, 1997

Problem Evaluation and Reflection Phase	Medicine	Nursing	Physical Therapy	Occupational therapy	Source
Case Formulation	X				Vertue & Haig, 2008
Making Predictions		X			Fonteyn & Ritter, 2008
Drawing Conclusion		X			Andersson et al., 2012
Evaluate	X	X	X		Carrier, 2013; Simmons et al, 2003; Smyrni & Nikopoulos, 2006
Hypothesis Evaluation		X	X	X	Gilland, 2014; Fleming, 1991; Jones, 1988 Rogers & Holm, 1991; Doody & McAteer, 2002
Summary	X				Audetat, 2013
Reflect on Process		X			Kuiper, 2013, Hunter et al., 2012
Prototype Case Reasoning		X			(Fowler, 1997)
Reflection	V	X	X	X	Carrier et al., 2012; Lapkin et al., 2010 Leicht & Dickerson, 2001 ; Kuipers, 2013; Scanlon,2010
Prognosis			X		Jones, 1992; Rivett, 1997
Reassessment			X		Jones, 1992; Rivett, 1997

Appendix B Email Template

From: Pam Joplin-Gonzales MSN, RN, PhD candidate

Subject: Identification of Essential Elements of Clinical Reasoning in Health Care Professionals; a Delphi Study

Date:

To:

My name is Pam Joplin-Gonzales and I am a PhD student at the University of Texas Medical Branch at Galveston Texas and I am conducting a Delphi Study to identify the essential elements of clinical reasoning in health care professions. During my literature review I sought to identify professionals who have published in this area who might be interested in participating in my study. You have been identified as a potential expert/participant in the area of clinical reasoning in health care professions because of your interest and publication in this area. Following you will find the details of the study

The purpose of this study is to identify the essential elements of clinical reasoning and seek consensus on these elements from a panel of content experts. The identification of these essential elements is critical in furthering the research on how to develop and teach the concept of clinical reasoning in all health care professions. The research question is: What are the essential elements of clinical reasoning in health care professions? The research methodology employed for this study will be a traditional Delphi study encompassing a Likert type questionnaire delivered via Survey Monkey®. During each round of the study you will be asked to rank different concepts as to their importance in the development of clinical reasoning.

The questionnaire will be delivered by Survey Monkey(R) and the link will be forwarded to you via email. In the initial round there will be a statement in the email explaining that clicking the Survey Monkey(R) link and completing the survey will imply voluntary consent. Participation is voluntary and you may withdraw at any time by contacting the Primary Investigator through the provided contact information. There will also be a short demographic survey for each participant to complete.

Participants' identifications will be coded using letters and/or numbers to maintain anonymity. Survey responses will be coded with a unique identifier. A separate identification key will be kept in a separate place from the surveys. These identification codes will be maintained in the Primary Investigator's office in a locked cabinet. Although Survey Monkey(R) is not anonymous, the experts' identifications and survey responses and print-outs will be kept confidential in a locked cabinet in the primary investigators office. Electronic results from Survey Monkey(R) will be kept in a password protected file on a computer in the researcher's locked office

At the initiation of the first round of the survey, the Primary Investigator will send an email notifying you that the link is open for the survey. You will receive emails reminding you to complete the survey during the fourteen day period. Experts who have not completed the survey after 10 days will be contacted to determine

any problems or concerns with the survey. It will be determined at that point by the Primary Investigator whether to extend the survey deadline of the study. After the period, the questionnaire responses will be retrieved and tabulated to develop a revised questionnaire. This process will continue as described in the above paragraph for three rounds. After the final questionnaire has been received and results tabulated a copy of the final essential elements will be sent to the content experts.

If you are interested in participating please open the link and start the first round survey and I will add you to the content expert list. Remember you have the right to withdraw from the study at any time without penalty. If you want to withdraw from the study contact me, and your data/information will be removed from the study results. Thank you for taking the time to read the information about my study and I look forward to your participation in the study.

Pam Joplin-Gonzales MSN, RN

PhD Candidate in Nursing

Graduate School of Biomedical Sciences

University of Texas Medical Branch

Galveston Texas

Appendix C: Essential Elements of Clinical Reasoning and Phases - Round One

	Problem Presentation Phase	Problem Assessment Phase	Problem Analysis Phase	Problem Hypothesis & Treatment Phase	Problem Evaluation & Reflection Phase
Elements	Cue Acquisition	Data Collection	Critical Thinking	Generate Hypothesis	Case Formulation
	Identify Cues	Examining Data	Context Formulation	Relationship bet. Cues	Making Predictions
	Attend to Cues	Investigate	Illness Scripts	Reflective Comparison	Drawing Conclusions
	Abstraction	Cue Acquisition	Analyze Data	Drawing Conclusions	Evaluate
	Generic Interview	Organize Knowledge	Deduction	Info into Clusters or Categories	Hypothesis Evaluation
	Source of Symptom Or dysfunction	Cue Logic	Searching for Info	ID Problems	Summary
	Pattern Recognition	Judging the Value	Organization of Info	Diag Test Comp	Reflect on Process
	Info Interpretation	Pattern Recognition	Pattern Matching	Causal Models	Prototype Case Reasoning
	Information Percep	Mnemonic	Data Gathering	Deduction	Prognosis
	Mental Representation	Draw on Past Exp	Processing Info	Hypotheses Testing	Reassessment
	Recognizing Problem	Evaluation	Consider Pt Situation	Intervention	
	Problem Identification	Intention, Goals Intervention	Reflect Evolving Concept	Problem Solution	
	Categorization	Setting Priorities	Providing Relationships Explanations	Proposing Action	
	Referral	Referral Question	Hypothesizing	Intervention	
	Tacit/Intuitive Knowledge	Pattern Confirmation	Framing	Take Action	
	Intuition	Causal Models	Drawing Conclusions	Management	
	Hypotheses	Hypotheses Gen	Hypotheses Testing	Decision	
	Predictive Reasoning	Contributing Factors	Intervention Planning	Diagnostic Mgmt	
	Initial Diagnoses	Initial Concept	Problem Formulation	Establish Goals	
			Contraindication to Treat		
			Cue Interpretation		

Appendix D: Essential Elements of Clinical Reasoning and Phases - Round Two

	Problem Presentation Phase	Problem Assessment Phase	Problem Analysis Phase	Problem Hypothesis & Treatment Phase	Problem Evaluation & Reflection Phase
Elements	Cue Acquisition	Data Collection	Critical Thinking	Generate Hypothesis	Case Formulation
	Identify Cues	Examining Data	Context Formulation	Relationship bet. Cues	Making Predictions
	Attend to Cues	Investigate	Illness Scripts	Reflective Comparison	Drawing Conclusions
	Pattern Recognition	Cue Acquisition	Analyze Data	Drawing Conclusions	Evaluate
	Info Interpretation	Organize Knowledge	Deduction	Info into Clusters or Or categories	Hypothesis Evaluation
	Info Perception	Initial Concept	Cue Interpretation	Intervention	Summary
	Intuition	Judging the Value	Organization of Info	Diag Test Comp	Reflect on Process
	Mental Representation	Pattern Recognition	Pattern Matching	Causal Models	Prototype Case Reasoning
	Recognizing a Problem	Draw on Past Exp	Processing Info	Deduction	Prognosis
	Problem Identification	Contributing Factors	Consider Pt Situation	Hypotheses Testing	Reassessment
	Categorization	Evaluation	Problem Formulation	Intervention	
		Setting Priorities	Reflect	Problem Solution	
		Pattern Confirmation	Providing Relationships		
		Causal Models	Explanations	Proposing Action	
			Hypothesizing	Establish Goals	
			Framing	Take Action	
			Drawing Conclusions	Management	
			Hypotheses Testing	Decision	
			Evolving Concept	Diagnostic Mgmt	

Vita

Pam Joplin-Gonzales was born on December 27, 1957 in Rapid City, SD to Clifford and Hope Joplin. She received an Associates of Science Degree in Nursing in 1987 from Edison Community College, a Bachelor's of Science Degree in Nursing in 1990 from The University of South Florida and a Master's of Science in Nursing with a minor in Education from The University of Texas At Austin in 1993. Her nursing background is in Adult Intensive Care to include Medical ICU, Coronary ICU, Surgical-Trauma ICU and Neuro ICU. She currently serves as a Tenured Assistant Professor of Nursing at San Antonio College Department of Nursing Education.

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The dissertation was typed by Pam Joplin-Gonzales