Pharmacists' Clinical Reasoning and Evaluation of Medication Appropriateness: Descriptive Analyses in Community Practice

by

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Abstract

The prevalence of drug-related problems puts a significant burden on the Canadian healthcare system. The literature that suggests that the majority of these drug-related problems are preventable, and could be identified and managed by pharmacists beforehand. This evidence suggests that pharmacists often miss opportunities to make decisions in regards to medication appropriateness. Therefore, it is essential to understand how pharmacists determine medication appropriateness to ultimately prevent drug-related problems. The research in this dissertation collectively aimed to understand what decisions pharmacists make in respect to medication appropriateness, and how pharmacists make these decisions. This objective was achieved through three related studies conduced in a community pharmacy setting: 1) a pilot study in a real-world setting that characterized what patient information pharmacists gather and how pharmacists apply the pharmacotherapy work-up when evaluating prescriptions, 2) a mixed-method study that characterized how pharmacists employ the patient care process when evaluating the appropriateness of prescriptions for a clinical simulation, and 3) protocol analysis of pharmacists' verbal reports that described pharmacists' clinical reasoning approaches.

In the pilot study, we found that the majority of pharmacists' time was devoted to dispensing activities. When pharmacists applied their clinical knowledge to check for medication appropriateness, it was primarily focused on checking medication safety, and covered more content areas when checking for new prescriptions in comparison to chronic refills. Furthermore, this study suggested that pharmacists rely mainly computer profile to collect patient clinical information, and they often asked patients non-specific questions, and missed patient cues. In the second study, we used a clinical simulation almost all pharmacists checked for medication

indication, safety, and manageability, but this check primarily occurred at pick-up consultations. The majority of consultations were initiated and led by the pharmacist in a form of a monologue or dyad. Similar to the pilot study, the computer printout often played an important role in shaping a routine check for drug–drug interactions and allergies (i.e., safety). Moreover, pharmacists often missed empathetic opportunities and cues.

In the third study, the majority of pharmacists used system 2 (i.e., analytical reasoning) to make decisions and system 1 (i.e., intuitive reasoning) was occasionally identified. In the CTA data, the majority of pharmacists were engaged in technical check for prescription accuracy, and they routinely checked for safety using system 2 reasoning. In structured RTA, pharmacists reported "overlooked" decisions and restructured decisions (i.e., hindsight reasoning) that did not appear in the simulation and CTA sessions. We also identified clinical reasoning approaches that were not identified in pharmacy studies before (i.e., automaticity, if/then, and dual process theory).

This dissertation demonstrates that pharmacists follow routines to check for medication appropriateness. This routine was primarily guided by technical check and reliance on patient profile and computer printouts. We suggest adapting these printouts to include the pharmacotherapy work-up elements (i.e., indication, effectiveness, safe, manageability) to create a clinical routine check. Future research should explore if pharmacists' reliance on technical and business-related routines is hindering them from applying appropriate clinical reasoning skills. We also recommend the replication of our methods (interconnecting phases of data collection and protocol analysis) to increase the depth and the completeness of studies in pharmacists' clinical reasoning.

Preface

This dissertation is an original work by Mohammad Nusair. The research project, of which this thesis is a part, received research ethics approvals from the Health Research Ethics Board (HREB) at the University of Alberta.

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Dedication

I dedicate this thesis to my first, last, and only love.

To my country, **Jordan**.

Acknowledgment

My interest in studying pharmacists' clinical reasoning and evaluation of medication appropriateness was inspired by my supervisor's research interests. Therefore, I would like to express my deepest gratitude and sincere appreciation to my supervisor Dr. Lisa Guirguis for giving me the opportunity to explore this field. I would also like to thank her for her unlimited support, and invaluable guidance throughout my doctoral program. I owe my deep gratefulness to Dr. Ken Cor for his support on all levels, endless advices on the development of my research projects. His comments were always constructive and inspiring. I would like to thank Dr. Mary Roduta Roberts for her valuable contributions, and guidance in this research.

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Abbreviations

3PQs	Three prime questions
CCC model	Check, Chat, and Chart model
CTA	Concurrent think-aloud
DRP	Drug-related problems
PCP	Patient care process
PTW	Pharmacotherapy work-up
RPh	Pharmacist
RTA	Retrospective think-aloud
SP	Simulated patient
TA	Think-aloud
WWHAM	Who is the patient; What are the symptoms; How long have symptoms been present; Action taken to date; Medication tried

Chapter One

Introduction

1.1 Overview

Pharmacists are the most qualified health care professionals to make proficient decisions in regards to medications.[1] Through their education and training, pharmacists can detect and solve drug-related problems, as well as ensure appropriateness of drug therapy. A drug-related problem is an undesirable patient experience with drug therapy that can or does interfere with desired patient outcomes.[2] In Canada, more than 599 million prescriptions are filled annually.[3], Pharmacists are expected to constantly checking for medication appropriateness, monitoring drug therapy, and resolving drug-related problems during routine encounters with patients in a community pharmacy setting. However, undetectable drug-related problems are highly prevalent in the Canadian healthcare system. More than 24% of hospital admissions are due to drug-related problems. Of these, more than 70% have been determined to be preventable.[4] This prevalence of preventable drug-related problems demonstrates that pharmacists have a large number of opportunities to make decisions in regards to medication appropriateness. The process that pharmacists use to determine medication appropriateness and identify and manage drug-related problems is called clinical reasoning. Understanding pharmacists' clinical reasoning is essential to ultimately preventing drug-related problems.

1.2 Clinical Reasoning

Clinical reasoning can be explained as the process of entertaining multiple possibilities while making a clinical judgment about a patient's condition.[5] This general definition gets more specific and complex when it is described in different healthcare professions as each profession has its own duties and responsibilities; in pharmacy, for example, clinical reasoning is the

process of identifying drug-related needs, while in medicine it is more focused on the cognitive thinking employed in solving diagnostic problems.[6]

The literature on clinical reasoning and decision making in the clinical domain can sometimes be confusing due to the use of interchangeable terms for the same phenomenon. The terms "clinical reasoning," "clinical judgment," "problem solving," "decision-making," and "critical thinking" are often used interchangeably in the literature.[7] In psychology, decision-making, problem-solving, and judgment are discrete areas of study, but in the clinical world they cannot be separated, and this may have contributed to the confusion of terms in the literature on decision-making in the clinical field.[8] In this dissertation, we will use the clinical reasoning term as it has multi-dimensions that fit with our research interest. Clinical reasoning is defined as the cognitive process through which practitioners apply their knowledge and clinical experience to assess and manage patients' medical problems.[9,10]

1.3 Underlying Methods and Theories in This Dissertation

Two theories, among many described in psychology, address clinical reasoning. These two theories are situated cognition theory and information process theory. Situated cognition theory promotes that learning and knowledge are dynamic and can change based upon interactions, the environment and how information becomes available in a specific context.[11-13] It explains the concept of context specificity by accounting for the dynamic interactions that occur between the clinician, the patient and the environment during a clinical encounter.[14-16] When this theory was applied in physicians' clinical reasoning studies, researchers found that clinical decisions are not solely the outcome of physicians' knowledge and thinking process. Other contextual factors that influence the clinical reasoning process include: practices setting, patient, clinician and the interaction between the clinician and patient.[14-16] In Chapter 2 and 3, we perhaps characterized

contextual factors similar to those described in the situated cognition theory. This was achieved by analyzing pharmacist-patient interactions using thematic analysis.

In this thesis, we did not use the situated cognition theory to characterize pharmacists' clinical reasoning (Chapter 4) for three reasons: 1) we aimed to describe the cognitive processes of clinical reasoning, 2) we had control over most of the contextual factors since it was a clinical simulation, and 3) we did not incorporate pharmacist-patient interaction sessions in the analysis. Therefore, we relied on an alternative theory to describe pharmacists' clinical reasoning at cognitive level.

The Information processing theory is the main theory underlying clinical reasoning research. This theory is guided by verbal reports that gives access to human reasoning described by Ericsson and Simon.[17,18] The verbal reports and information processing theory can work hand in hand to describe pharmacists' clinical reasoning process. The verbal data obtained from a think-aloud is an accurate reflection of short-term memory and the information that is being processed at that time, which, according to information processing theory, is exactly what we need to understand pharmacists' clinical reasoning process.

1.3.1 Verbal Reports

Verbal reports are data generated when subjects provide verbal descriptions of their cognitive thinking and experiences without using introspection.[18] Verbal reports have been extensively used in health care research to study clinical decision-making and expertise.[6] In these studies, in order to concentrate on the given task, subjects verbalize their thoughts and actions without theorizing their cognitive thinking or reflecting on what they are doing.[6,19,20]

Two sources of verbal reports will be used in this research: 1) concurrent think-aloud, in which participants verbalize what they are thinking and doing while working on a given task, and 2) retrospective think-aloud where participants complete the given task and verbalize their process only afterward.[21]

1.3.1.1 Concurrent Think-aloud (CTA)

Thinking aloud during problem-solving means that the subject keeps talking and speaks out loud whatever thoughts come to mind while performing a given task.[20] The think-aloud method has its roots in psychological research and became a common practice in assessing cognitive thinking in clinical reasoning research.[22] Using the CTA method helps to better clarify participants' intentions, reasons, and actions, which we sometimes cannot explain or understand through observations alone.[23]

The think-aloud method is a direct way for subjects to report from their short-term memory without delay. The direct reports from the short-term memory are reliable as long as we minimize the demand on the short-term memory.[20] CTA do not overload the short-term memory. This is because subjects: 1) concentrate only on the given task without any interruptions or questions; 2) report heeded information in the short-term memory without any interpretation, editing, or theorizing of subjects' thoughts; and 3) use their own language while performing the task, making it easier for them.[18,20,24-26]

However, there are some concerns regarding CTA. One is the possibility of incomplete reports because only heeded traces (i.e., what the subject is attending to or aware of) will be verbalized and, as a result, parallel or automated processing will be not reliably reported.[18,24,26] Reactivity is another concern with verbal reports: it refers to the possibility of subjects performing better than usual because of the structured task, or worse than usual due to the double work load.[24,25,27]

Another concern with think-aloud protocols is nonveridicality when subjects do not accurately reflect "the underlying primary process".[25] Nonveridicality includes errors of commission (i.e., reporting mental events that did not occur), and errors of omission (i.e., not reporting some mental events).[25,28]

1.3.1.2 Retrospective Think-aloud (RTA)

Retrospective protocols are collected after performing the task, which requires the research subjects to talk aloud or think aloud after the task is completed.[21] Data collection and analyses of retrospective protocols can be similar to the think-aloud method, but while unlike in the think-aloud, in which subjects verbalize their short-term memory, in retrospectives they report a mixture of short- and long-term memory information.[29] Therefore, retrospective protocols can be used to characterize processes that are not dependent on the concurrent presentation of the stimulus material.[6] Subjects only verbalize their thoughts on their task performance without needing to actually engage with the task.[27]

Retrospective protocols seem to have a lower risk reactivity in comparison to think-aloud protocols;[25,27] in retrospective protocols, subjects perform the task in their own way and at their own pace and are not likely to perform better or worse than usual. In CTA, subjects are more susceptible to reactivity.[27,30] There are more advantages to retrospective protocols: they provide a valid account of complete verbal reports and are less susceptible to the influence of task difficulty.[21,27]

Despite their advantages, RTA also have some drawbacks. Firstly, they are constrained by the limitations of the subjects' memory; retrospective protocols require the subject to access information from long-term memory, but not all information related to the given task (short-term memory) will be fixed in the long-term memory, and even the fixed information may not be

retrievable on demand.[24,31] The second drawback is a subject's tendency to reconstruct rather than report the actual cognitive thinking; with the delay between performing a task and providing a retrospective verbal report, a subject may be at risk of editing, introspection, or giving false reports.[18,24,32] In RTA, subjects have direct contact with the researcher; therefore they may report what the researcher wants to hear, leading to a reporting bias.[18,20,24]

These drawbacks can be minimized by: 1) conducting RTA sessions as soon as possible after completing the task; 2) emphasizing the importance of accurate reports; and 3) avoiding leading questions and probing, as needed, for clarification (what, which) rather than evaluation (why).[18,24,32]

As aforementioned, there are concerns about and limitations to both types of verbal reports (i.e., CTA and RTA). A dual methodology approach can enhance data in terms of completeness, validity, and reliability, as it will generate different kinds of information for one particular task and reduce interpretation errors.[18,24,26]

1.3.2 Information Processing Theory

Information processing theory was first introduced by Newell and Simon (1972) in their work examining experts' problem-solving.[29] It is a descriptive theory that provides a useful framework for understanding clinical reasoning. Information processing theory proposes that human reasoning consists of a relationship between the problem-solver and the task environment or the context in which problem-solving occurs.[29]

There are two systems of memory: the short-term (working) memory, which has a small capacity in which presented information is stored and processed with some information retrieved from long-term memory, which has infinite storage space for information.[29] According to information-

processing theory, the main factor that limits humans' capacity for information processing is the structure of human memory. There are limits to how much information one can process at any given time. Effective problem-solving is the result of being able to adapt to these limitations.[29] Miller (1956) demonstrated that an individual's short-term memory is limited to seven items plus or minus two.[33] Newell and Simon suggested that the capacity of working memory can be increased by grouping or chunking related items into familiar patterns.[29] Long-term memory stores the information gained from knowledge and experience throughout life. Stimuli being processed in the working memory can unlock and solve this knowledge.[29,34,35] To solve a problem, clinicians need to use operators in order to retrieve the knowledge needed from long-term memory. Decisions are made through a sequence of cognitive work by using operators unconsciously until the problem is solved.[18,34,36-38] These operators gradually become more organized and efficient through academic learning and clinical experience.[6,39,40]

Clinical reasoning is an aggregate of operators that represent patterns of reasoning. For example, in a systematic reasoning the operators "collect," "choose," "study," and "read" can be used for cue acquisition; followed by "conclude" and "diagnose" to generate a hypothesis.[36,41,42]

1.4 Clinical Reasoning in Pharmacy

Patient-care process is the primary clinical reasoning framework adopted by professional organizations and taught in pharmacy schools in North America.[43-45] Patient-care process is a comprehensive and systemic problem-solving process designed to ensure that patients' drug-related needs are met and that medication therapy is appropriate.[46]

Patient-care process involves pharmacists interacting with patients to make decisions in order to achieve appropriate drug therapy, and resolve any drug-related problems.[46] The patient-care process consists of (a) an assessment of the patient's drug-related needs, (b) a care plan to meet

the specific needs of the patient, and (c) a follow-up evaluation to determine the impact of the decisions made.[46] Pharmacists make rational drug-therapy decisions in the assessment part using a pharmacotherapy work-up. This is a logical process that guides pharmacists' decisions when they check for appropriateness (i.e., indication, effectiveness, safety, and compliance).[46,47] To date, there is no clear investigation into community pharmacists' clinical reasoning when they check for medication appropriateness.

A few studies in the literature that explored pharmacists' clinical reasoning in regards to diagnosis and adverse drug-reaction detection.[48-53] In a recent study, pharmacists' clinical reasoning patterns was characterized using a mix of protocol and thematic analyses for think-aloud and non structured probed interviews. Pharmacists in this study did not express a clear clinical reasoning; however, they showed a pattern of educating and building a relationship with the patient, and using "I'm just following the rules" to make excuses for not making clinical decisions.[50]

Another study by Akthar and Rutter explored community pharmacists' clinical reasoning in diagnostic decisions. In this study, 10 pharmacists were asked to work through a case scenario to arrive at a diagnosis. Using Think-aloud techniques, pharmacists provided a rationale for the questions they asked the standardized patient. The majority of the pharmacists in this study gathered information using a structured approach, *Who is the patient; What are the symptoms; How long have symptoms been present; Action taken to date; Medication tried* (WWHAM). This approach is commonly used in pharmacy practice to facilitate conversations with patients and find out more about their conditions. However, using WWHAM did not appear to be a success as pharmacists failed to make the right diagnosis using this approach. Three pharmacists met the expected outcomes of this study; they arrived at the right diagnosis and provided a self-care plan.

These three pharmacists used a more thoughtful approach and relied on matching the patient's signs and symptoms to their previous experience and knowledge.[52]

A similar study by Iqbal and Rutter aimed to explore pharmacists' clinical reasoning when making a diagnosis. Four pharmacists participated in this study; they interviewed the standardized patient, who presented with a headache. The authors reported that they used the think-aloud technique in this study, but it was not clear how they conducted the think-aloud sessions. Three pharmacists in this study used WWHAM. None reached the correct diagnosis and, consequently, none devised an appropriate care plan. This study suggested that pharmacists did not incorporate any of the previously mentioned clinical-reasoning approaches because they did not link any of the information they gathered. The authors did not elaborate much about the methods and results as this study was published as a short report.[48]

A study by Rutter and Patel aimed to explore how community pharmacists make a diagnosis regarding a dermatology condition. Ten pharmacists were recruited for this study, and were asked to think aloud as they interacted with one of the researchers, who posed as a patient with a skin rash. Rutter and Patel did not report their analysis methods in detail but transcripts suggest that they used a thematic analysis. The analysis identified two major components to the patient consultations: 1) establishing a diagnosis through information gathering, and 2) therapeutic management planning. The latter was not the main objective of their work so they did not elaborate.[51]

In the same study, Rutter and Patel identified three sub-themes involved in establishing a diagnosis: questioning strategy, question framing, and underpinning knowledge. Pharmacists' diagnostic reasoning was influenced by their information gathering and the WWHAM approach. Their reasoning approach was not clearly articulated in the think-alouds. Pharmacists' questions

were mainly close-ended and they appeared to lack a logical sequence or purpose; in 50 percent of the cases pharmacists asked diagnostic questions after they recommended a treatment plan. This study suggested that pharmacists in the United Kingdom have gaps in knowledge and that the WWHAM approach restricts their clinical reasoning.[51]

Phansalkar et al. conducted similar research to explore pharmacists' clinical reasoning when detecting adverse drug events. Five clinical pharmacists discussed case scenarios in focus group sessions which the authors described as think-aloud protocols.[49] Think-aloud sessions are typically conducted individually, not in a focus group. Focus group reports do not reflect actions that take place in real practice,[54] and participants may change their reasoning due to reactivity and social desirability. This study analyzed verbal reports using a combination of discourse and protocol analyses.[49] The results suggested that expert clinical pharmacists followed a forward-reasoning approach. Pharmacists used the information on patients' charts to make hypotheses about possible adverse drug events and validated them (i.e., hypothetico-deductive approach).[49] Pharmacist-patient interactions (i.e., consultations) were missing in this study; therefore, pharmacists reported the need for further information in order to make drug-related decisions.

Furthermore, a dissertation by Bartels aimed to examine pharmacists' clinical reasoning in an ambulatory care setting and compare it to the existing literature in other health care disciplines.[53] Bartels recruited six pharmacists in her study, and gathered three types of audio recordings: 1) direct observations of pharmacist-patient interactions, 2) interviews with the pharmacists after their interactions with patients to describe their clinical decisions, and 3) pharmacists' narrative reflections on how they made clinical decisions each day over a period of two weeks.[53]

Bartels used the thematic analysis methodology to identify emerging themes of pharmacists' decision-making. She identified two main themes that describe how pharmacists made clinical

decisions for drug therapy: 1) "objective knowledge" of disease states, drugs, guidelines, laboratory values, health education, medication, and over-the-counter therapies; and 2) "context-related knowledge" that pharmacists used to make decisions. This context-related information is specific to individual patient situations such as patient's past use of medications, motivation, and other health trends.[53]

The results of this thematic analysis proposed an "experience-based type of decision-making". This method is a constant internal experimentation and reflection activity in which pharmacists start with gathering "objective" and "context-related knowledge" followed by a modification step. In the modification step, pharmacists perform a continuous dialogue and reframing of unsolved problems until they reach a clinical decision.[53]

Experienced pharmacists demonstrated experienced-based type decision-making model; an unconscious inclusion of objective knowledge and context-related knowledge.[53] Therefore, this model is not exclusively analytical (e.g., hypothetico-deductive) or intuitive (e.g., pattern recognition). Pharmacists can apply analytical and intuitive reasoning in constant modification to make final clinical decision of drug therapy.[53] The reliance on one approach exclusively was not often expressed by novices.

In summary of these studies, clinical reasoning literature in pharmacy suggests that pharmacists use analytical reasoning approaches (e.g., hypothetico-deductive), intuitive (i.e., pattern recognition) or a combination of both. However, these studies have limitations that may have led to incomplete results. The majority of these studies involved a thematic analysis of verbal reports to describe the overall decision-making and pharmacists' behaviours; however, it is insufficient to describe pharmacists' clinical reasoning in depth. In concordance with the information

processing theory, protocol analysis of verbal reports is essential to this type of studies to provide in-depth analyses of operators to describe the clinical reasoning process.

Furthermore, some studies think-aloud data were collected as pharmacists were interacting with the researcher or in focus groups.[49,52] Such interruptions in a think-aloud protocol could influence pharmacists' thoughts and behaviours, resulting in biased reports.[20] The concurrent question asking or using prompts by the researcher while pharmacists working on a case may disrupt pharmacists' working memory or cause pharmacists to retrieve information from their long-term memory.

1.5 Gaps and Problem Statement

Pharmacists make decisions regularly to determine medication appropriateness and identify and manage drug-related problems. However, there is limited information as to whether pharmacists are regularly making these decisions in routine encounters, and how these decisions are being made.

It is important to develop a clear understanding of the clinical reasoning pharmacists currently use in their daily practice. This information has yet to be described in-depth in the pharmacy literature.

1.6 Objectives

The broad intent for this thesis is to ultimately prevent drug-related problems and improve patient outcomes by understanding what decisions pharmacists make in respect to medication appropriateness, and how pharmacists make these decisions. By doing so, the main objectives of this thesis are to:

1) Characterize how pharmacists collect patient information and apply the patient care process when evaluating medications in community pharmacy settings.
2) Describe pharmacists' clinical reasoning when they check for medication appropriateness.

1.7 Dissertation Outline

Three studies were conducted to meet the overall dissertation objectives. The first study (Chapter 2) is a pilot study in which we characterized how community pharmacists in Alberta gather patient information and how pharmacists evaluate prescriptions using the Chat, Check, Chart model (i.e., a communication model).[55] We used a mixed method design for this study. We conducted quantitative analysis to describe pharmacists' use of the three prime questions, and the four evaluating questions of the pharmacotherapy work-up. We also conducted a qualitative analysis using a generic qualitative approach to describe pharmacists' information-gathering and perceptions evaluation.[56] This pilot study helped us to improve data collection and analyses for the subsequent two studies and overcome some of the limitations we encountered.

In the second study (Chapter 3), we characterized how community pharmacists in British Columbia gather patient information and how they evaluated appropriateness of therapy using the patient care process. Similar to the pilot study in Chapter 2, we used a mixed method design for this study. We conducted quantitative analysis to describe pharmacists' use of the patient care process elements. We also conducted a generic qualitative approach to describe pharmacists' information-gathering and medication evaluation. In Chapter 4, we described pharmacists clinical reasoning for evaluating therapy for a simulated patient. We conduced protocol analysis for two types of verbal reports, concurrent and retrospective think-aloud.

Chapter Two

How Pharmacists Check The Appropriateness of Drug Therapy? Observations in Community Pharmacy.

Mohammad B. Nusair, Lisa M. Guirguis

A version of this chapter has been published in Research in Social and Administrative Pharmacy

Nusair MB, Guirguis LM. How pharmacists check the appropriateness of drug therapy? Observations in community pharmacy. *Res Social Adm Pharm*. 2016. (Appendix 1)

2.1 Abstract

Background: In Alberta, the Chat Check Chart (CCC) model was developed to help pharmacists understand how patient care standards fit into routine practice. The CCC model outlines a process that covers the following: 1) Chart—asking three prime questions to gather information; 2) Check—perform pharmacotherapy workup by assessing prescription's indication, efficacy, safety and manageability; and 3) Chart—document findings of the pharmacotherapy workup.

Objectives: To characterize how pharmacist collect patient information and apply the PTW when evaluating routine prescriptions in community pharmacy settings.

Methods: An observational study with a mixed methods analysis was employed. Participants were surveyed and audio recorded talking with patients, as well as thinking aloud while evaluating medication therapy. Quantitative analysis was conducted to describe the proportion of time allotted to clinical or technical duties when using the 3PQs and PTW in routine practice. A generic qualitative approach was conducted to describe how the pharmacists evaluated prescriptions and counseled patients.

Results: Nine pharmacists from five different pharmacy stores participated in this study. Fifteen recordings of consults and 14 think-alouds were eligible for analysis. Pharmacists allotted 16% of their think-aloud on clinical related issues for new and chronic medications, and the remainder on technical dispensing activities. All pharmacists checked if the medication was safe, but less than half checked if the prescription was indicated, effective, or useable (i.e., adherence). Pharmacists covered more content areas when checking the appropriateness for new prescriptions in comparison to chronic refills. Four overarching themes arose from the qualitative analysis: missed opportunities, absence of personalized assessments, reliance on routine pharmacist activities, and nonspecific questions.

Conclusions: Pharmacists gathered insufficient clinical information to assess their patients' medication therapy as they overly relied on the patients' profiles, asked patients non-specific questions, and missed patient cues. Routine activities appeared to shape practice including a bias against refill prescriptions and a focus on technical dispensing activities.

Keywords: Mixed methods; Patient assessment; Pharmacotherapy workup; Think aloud; Consultation; Community pharmacy

2.2 Introduction

Over 40% of Canadians take prescription medications and this number rises to 83% for those over 65 years of age.[57] One in seven adult Canadians has two or more chronic diseases, which often necessitates multiple medication therapy.[58] Polypharmacy- taking 5 or more medications- was at 11% for Canadians aged 45-64 and 30% for Canadians over 65 years of age[57] Increasing the number of medications increases the risk of adverse drug reactions and subsequent hospitalization. A systematic review found that 4.6-12.1% of hospitalizations were due to drug-related problems (DRP).[59]

Pharmacists are well positioned to meet health needs as the most accessible healthcare provider with expertise in medication management.[60] Pharmacists can apply the skills in pharmaceutical care to prevent DRPs, monitor medication therapy and optimize patients' medication therapy.[46] Pharmaceutical care is "the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life".[61] Pharmacists' provision of pharmaceutical care has been shown to have a positive impact on patient outcomes,[62-67] and improve economic outcomes. [68,69]

In the pharmaceutical care model, pharmacist's core cognitive function is assessing the appropriateness of a medication therapy for an individual patient. This is commonly known as the pharmacotherapy work-up (PTW), whereby a pharmacist determines if a therapy is indicated, effective, safe, and manageable for a specific patient after gathering the required information.[46] This has also been referred to as the "Clinical Check".[70] Both gathering the information and completing the PTW for a patient are often referred to as the patient assessment portion of the pharmaceutical care.[46] The PTW defines pharmacists' unique cognitive contribution to patient care. Using the PTW as a part of pharmaceutical care has resulted in improved clinical outcomes

in 83% of patients and over a million dollar health care saving.[71] However, research has not yet empirically characterized how pharmacists conduct the PTW in community pharmacies where medication dispensing often remains a part of practice.

Research has characterized patient assessment in professional nursing and medicine.[6] However, pharmacists have a distinct focus and training on medication appropriateness. Two studies empirically examined pharmacists' thought processes and suggested that pharmacists use a combination of structured reasoning as well as recognition of common patterns to solve simulated clinical cases.[49,52] The aim in this preliminary research is to advance pharmacy practice literature by assessing how community pharmacists assess medication therapy using direct observations.

In Alberta, community pharmacists have struggled with the practice change and reported that most of their practice time is allotted to dispensing activities.[72,73] For this reason, a partnership between a faculty member of the University of Alberta and the Alberta College of Pharmacists created a practical model to help pharmacists understand how the patient care fits into routine dispensing practice. The Chat Check Chart (CCC) model outlines a process in which pharmacists gather information (Chat), evaluate medications for appropriateness using the PTW (Check), and document patient care (Chart) using recognized tools or processes. Chat consists of three prime questions (3PQs) where the pharmacist asks three open-ended question to explore the patient's understanding about 1) the purpose of taking the medication (PQ1), 2) directions (PQ2) and 3) medication monitoring (PQ3). Again, Check consists of the PTW process. Chart is a brief data, assessment and plan (DAP) note format, and it is not routinely used in practice.[74,75] The Check Chat Chart model succinctly clarifies the standards of practice in Alberta, and is used to assess the quality of patient care. The Check Chat Chart model has increased pharmacists' self-efficacy

and role beliefs towards assessment and documentation, as well as motivated pharmacists to enhance routine care.[76,77] This observational research will focus on Chat and Check; in which community pharmacists gather patients' information, assess medications appropriateness, and provide tailored patient information.

2.3 Objectives

The purpose of this observational study with a mixed method analysis is to characterize what patient information pharmacists gather (i.e., 3PQs) and how pharmacists apply the PTW (i.e., indicated, effective, safe, and manageable) when evaluating routine prescriptions in community pharmacy settings.

Specific objectives are to measure the extent to which pharmacists use elements of the 3PQs and PTW in routine community practice, describe the proportion of time allotted to clinical or technical duties, and determine if there are differences in the use of the 3PQs and PTW for new fill and refill prescriptions. Simultaneously, a generic qualitative approach [56,78] was to explore how pharmacists apply the 3PQs and PTW.

2.4 Methods

2.4.1 Design

This observational study employed an embedded concurrent mixed method design.[79] The converging of qualitative and quantitative analyses allow for the calculation of the frequency as well as a rich description of how pharmacists gathered patient information and applied the PTW in routine community practice. The data consists of audio recordings of pharmacist-patient interactions (i.e., consultations) and think-alouds. In the think-alouds, pharmacists verbalized what they were doing, thinking about, and looking at in order to characterize their clinical

decision making.[18] The think-aloud technique has its roots in psychological research and has become a common practice in clinical decision making since it was introduced in the 1970s.[8,22] The think-aloud has been useful in pharmacy practice research for understanding pharmacist-patient communications, pharmacists' cognitive thinking, and process of electronic prescription.[48,49,51,52,80-83]

2.4.2 Participants

A pharmacy chain partnered with researchers. Two regional managers designated five pharmacy stores with differing levels of busyness were chosen as well as one rural site were included. All pharmacists and pharmacy store managers individually consented to participation in the study. Documentation of patient care (i.e., Chart) was not collected as it was not part of that original research objectives. At the time of this study, the CCC model and the related standards for practice were widely available, but this cohort of pharmacists had not received specific training.

2.4.3 Data Collection

Survey

The pharmacists' surveys provided basic demographic information and gathered quantitative data to analyze burnout and role conflict experienced by pharmacists. Role conflict is the presence of two or more sets of expectations that are incompatible.[84,85] Role conflict was measured with a 9-item scale and has prior evidence for its reliability and validity.[84,85] Pharmacists also reported their perceptions of the busyness of their pharmacy. The survey data was used to describe the sample (Table 2.1).

Observations

Pharmacists approached patients who were dropping off prescriptions, asked if they were interested in participating, and referred patients to a researcher who obtained the patients' written consent. Next, the researcher audio-recorded both the pharmacists' talking with patients when the prescription was dropped off or picked up (i.e., consultation) and the pharmacists' thinking process when preparing the medication (i.e., think-aloud). During the think-aloud portion, the pharmacists were asked to verbalize what they were thinking about, looking at, and doing when preparing the medication (i.e., entering data into the computer, physically preparing the medication, and assessing the final prescription) as if they were explaining this task to a junior pharmacy student.

2.4.4 Data Analysis

Analysis was completed using NVivo 10 and SPSS version 21 (IBM, IL., USA) to manage both quantitative and qualitative data.

2.4.4.1 Quantitative Analysis

A quantitative codebook was developed to define the coding for each of the 3PQs and the four elements of the PTW. All instances of the 3PQs were coded during the consultation as an open-question, a closed question or a question asking what the doctor said. In some recordings, pharmacists discussed the topics of the 3PQs with patients rather than asking questions, so that portion of the 3PQs coding was included and referred to these instances as given information. PTW elements were coded during the think-aloud portion of the audio recording. The incidence of each PQ and PTW element was counted as if occurred or not (i.e., zero or one). Repeated incidences for the same prescription were not counted. Since the sample did not have equal numbers of new prescriptions and refills, the percentage of incidences were used to compare the

incidence of PQ and PTW elements. Percentage of incidence was calculated by dividing the incidence of each element by the total number of prescriptions (Table 2.2 and 2.3).

Clinical and technical times were measured in seconds. Clinical times include when the pharmacist was discussing clinical related issues with patients (e.g., 3PQs, asking about medical history, allergies) or thinking aloud about clinical related issues (e.g., PTW, past medical history). Technical times include when the pharmacist was discussing technical issues (e.g. insurance, paying the bill) or thinking aloud about technical things (e.g. counting pills, labeling, and checking the prescriber's name). The clinical and technical times in seconds were divided by the total seconds of each recording to calculate the percentage of clinical and technical times.

MN and a research assistant independently coded the recordings. Differences in coding were discussed and resolved by a third person (LMG) if necessary. Inter-rater reliability was assessed using Cohen's kappa. The kappa value for the two coders was 0.82, which indicates a good agreement between the two coders. Descriptive statistics were used to calculate the occurrence of the 3PQs and PTW.

Pharmacists' surveys were analyzed and overall median scores of constructs (i.e., work burn out and role conflict) were calculated by taking the mean of related questions for each construct separately.

2.4.4.2 Qualitative analysis

All instances where pharmacists discussed clinical issues were transcribed in both think-aloud and consultations. Transcripts were analyzed using a generic qualitative approach.[56,78] Transcripts were reviewed and coded for two purposes: 1) to describe how the pharmacists

evaluated prescriptions and counseled patients and 2) to describe how the pharmacists used the 3PQs and PTWs in consultations and think-alouds, respectively.

Two authors (MN, LMG) reviewed the audio recordings to get a sense of the whole and then independently identified relevant codes and formulated a general description to the use of each of the PQ and PTW. Based on these codes and descriptions, themes were generated through an interactive process of discussion and recourse to the data.

2.5 Results

Nine pharmacists participated in the study with an average of (mean ± S.D., 12.8 ± 13.0) years of experience in practice, as represented in Table 2.1. Five pharmacy stores in Alberta with one rural and four urban were included in the study. All the stores had a private counselling room. The pharmacists reported "a moderate amount" of work burnout (1.5 ± 1.1) and "disagreed" (3.2 ± 1.1) with having any role conflict (Table 2.1). The results of the think-alouds will be presented first then the consultations as pharmacists asked the 3PQs after the PTW in 13 out of 15 interactions.

2.5.1 Quantitative

Pharmacotherapy Work-up Analysis

Fourteen think-alouds were recorded and analysed, four think-alouds were recorded for seven new prescriptions, and 11 think-alouds for 13 refills. The pharmacists spent almost 80% of their time on technical checking activities. The proportion of time for clinical and technical checking tasks was similar between new prescriptions and refills (Table 2.3).

No pharmacist explicitly checked for prescriptions using all four elements of the PTW (Table 2.5). In 13 of the 15 think-alouds, pharmacists gathered clinical patient information (i.e., 3PQs)

after the prescription was checked. Pharmacists used information provided in the profile such as refill intervals, medication allergies, interactions, and the presence of medical conditions to check for clinical appropriateness.

There was one instance of a pharmacist checking PTW1 (i.e., indication). Pharmacists checked for PTW2 (i.e., efficacy) in three think-alouds: two for new prescriptions and one refill. They checked if the dose appeared to be in the standard range for two new fills or whether the patient had used sufficient doses to be effective since the last refill.

Pharmacists checked for prescription PTW 3 (i.e., safety) in all think-alouds (21 instances), and in almost all cases pharmacists checked for safety by checking for drug interactions, allergies, and drug disease interactions as per information on patient profile.

Six pharmacists checked for PTW4 (i.e., adherence) to prescriptions in 11 TAs (11 instances), eight for refills, and three for new prescriptions. For refills, pharmacists checked for patients' adherence by checking the patients' profile for refill intervals. For new prescriptions, they added auxiliary labels to remind patients to finish all medication for new acute prescriptions or about the next refill for the repeated ones.

Consultations

Sixteen consultations were recorded; one consultation was excluded because it was incomplete. Fifteen consultations with 21 prescriptions were analysed. Five consultations were for seven new prescriptions and the remaining ten were for 14 chronic refills or previously used prescriptions (Table 2.2).

Overall, pharmacists allotted 27% of total consult time discussing clinical issues with their patients. The amount of clinical time for new prescriptions was nearly double the clinical time for refills (Table 2.2).

Pharmacists discussed at least one of the 3PQs topics in 61.9% of interactions (Table 2.2). Pharmacists discussed PQ1 on the purpose of medication in five out of the seven new prescriptions, mainly using leading closed questions (i.e., declarative questions) to verify the potential use of new medications (Table 2.4). In this way, pharmacists displayed their knowledge of the medication before double checking for accuracy with the patient.

Pharmacists discussed PQ2 (i.e., direction) & PQ3 (i.e., monitoring) for new prescriptions more frequently than for refills (Table 2.2). PQ2 was initiated by pharmacists giving information on the directions (8 instances), and by pharmacists asking questions or patients asking questions (7 instances). Pharmacists asked three types of questions: 1) an inquiry of what did the doctor say (4 instances) 2) closed questions (2 instances) and 3) one open question (Table 2.4).

Pharmacists discussed PQ3 in half of consultations (Table 2.2). They focused on adverse reactions, mainly in the form of giving statements (i.e., 6 instances) rather than questions (i.e., 2 instances; Table 2.4). Pharmacists discussed benefits and positive outcomes of therapy in 3 instances. In the 21 prescriptions, pharmacists asked or discussed no PQ in eight prescriptions (7 refills and 1 new), one PQ in four prescriptions (all refills), two PQs in four prescriptions (3 refills and 1 new), and three PQs in five prescriptions (all new).

2.5.2 Qualitative

Four overarching themes described how pharmacists evaluated prescriptions and counseled patients (Table 2.5): *Missed Opportunities, Depersonalized Assessments, Reliance on Routines* and *Nonspecific Questions.*

Missed Opportunities

This overarching theme appeared primarily but not strictly in think-alouds and included the following three sub-themes: *Assumptions, Missed Patient Cues* and *Instinctive Judgements*.

Assumptions: Pharmacists seemed to check for prescription appropriateness using incomplete information and act on assumptions or hunches. Two pharmacists assumed that the dose was appropriate without checking the indication based their perception that "it is pretty commonly used that way" (RPh 1200) or being "familiar with it, it is a standard dose" (RPh 5300). One pharmacist assumed that the patient knew how to apply a newly prescribed cream.

(RPh 2100/Pt)

RPh: "So is this a new medication for you?"

Pt: "Yes."

RPh: "But I think you are quite aware of how to use it, right?

Pt: "Uh, you can remind me if you like"

Missed Patient Cues: Pharmacists often missed some of the patients' cues. Some patients gave cues that indicated their confusion, uncertainty, or hesitation about their medications; these cues could be inferred from their tone of voice or behaviours. In the previous example (RPh 2100), there was hesitation in the patient's response about knowing how to use his medication "Uh, you can remind me if you like". Pharmacist (2100) missed that cue and did not tell the patient how to use his medication.

Instinctive Judgments: No pharmacist made an explicit check all of the four elements of PTW. In some places, pharmacists seemed to make a complete assessment of prescriptions instinctively without actually verbalizing it. In one audio recording, the pharmacist checked for the safety

element of PTW and decided quickly that it "looks good": "no significant interactions to check; everything looks good" (RPh 5300).

Depersonalized Assessments

This overarching theme included two sub-themes: *Profile & Product Focused* and *Almost Completely Technical*.

Profile & Product Focused. In most cases, pharmacists checked the prescriptions' appropriateness using patients' profile information on the computer before discussing medications with patients. Pharmacists thus may not be aware of indication for new prescriptions and efficacy and adverse events for refills. In some cases, pharmacists started new profiles for new patients and did not gather information on other medications or medical conditions. However, pharmacists explicitly checked for drug- drug and drug-disease with these incomplete profiles. In one audio recording, a pharmacist checked if the patient was getting the full benefit of his inhaler by checking his profile and did not confirm therapy outcomes with the patient later in the consultation:

Almost Completely Technical. Some consultations were completely technical and pharmacists did not counsel the patient at all.

(RPh 4200/Pt):

RPh: "So your total is 74.55 and do you have XXX card?"

Pt: I don't but my mom does.

RPh: That's alright. I just need you to sign there that you picked it up today".

RPh 5200 and 3100 were also solely technical in both consultations and think-alouds to the extent that the patients' medications or medical conditions could not be identified. Both pharmacists stated the quantities dispensed and refills remaining.

Reliance on Routines

Pharmacists appeared to have common routines that shaped their practice. Three sub-themes were identified under routines: *Hardcopy Check, Refill Bias,* and *Rewards Card*.

Hardcopy Check: Most pharmacists assessed appropriateness in a routine manner. Pharmacists could be heard systematically reviewing interactions, allergies, and refill intervals on the prescriptions' hardcopy (i.e., computer printout). The checking procedure associated with the hard copy was focused on technical items mainly (e.g., correct doctor and patient names) and clinical items related to safety and refill intervals. Pharmacists focused on the hardcopy elements rather than patients' clinical experiences or outcomes. In one extreme example, one pharmacist followed the same routine with test strips to check blood sugars and stated, "I check interactions, allergies, and medical conditions, none of which I think is significant" (RPh 2200).

Refill bias: Pharmacists typically checked for refill safety and refill intervals. There were no instances that captured pharmacists evaluating the effectiveness of a refill. Pharmacists verbalized this refill bias, "This is a refill for XXX. I am not too concerned about counselling her on usage or dosing or storage because I think she is familiar with that" (RPh 2200).

Another example of reliance on routines was the *Rewards Cards* or loyalty program cards (i.e., cards made by the store that allow customers to get price reduction or special promotions). Pharmacists asked for the patients' reward cards in 11 of 15 consultations. One patient appeared to be used to this routine in consultations.

(RPh 5300/Pt):

RPh: Did you have any questions or concerns on it today?

Pt: "No, I am just looking for my XXX card"

Nonspecific Questions

In almost every consultation, pharmacists used broad, general, or *Nonspecific Questions* to check for patient concerns or understanding. In some recordings, only non-specific questions characterized the consultations. *Nonspecific Questions* included two types of questions or themes: *Any Questions?* and *Still Okay?* Patients generally responded with "No, I don't have any questions" or "Yes, I am still okay", except on two occasions (RPh 1100, 5300) where the patients had a question related to directions (PQ2).

In some refill consultations, pharmacists checked if the patients had any issues with their medications by asking if they were *Still Okay* with their medications. RPh 2200 used this type of question when he was counseling a patient about her and her husband's medications.

(RPh 2200/Pt):

RPh: "And are you okay with this one?"

Pt: "Yes I am"

RPh: "And is he okay using all of these?"

Pt: "Yes he is"

RPh: "Any concerns with them?

Pt: "Nope. Nope, he is okay."

In some cases, pharmacists asked "any questions or concerns" upfront in the consultations for agenda setting purposes, and if the patients did not have any concerns, then pharmacists would bring their own agenda.

(RPh 1200/Pt)

RPh: "Did you have any questions or concerns?

Pt: "Nope. I have been taking it for probably 5 years."

RPh: "Okay, have you talked to your doctor about stopping it…."

Pharmacists also used nonspecific questions to end consultations. The following consultation, typifies how pharmacists use *Any Questions* to signal an end to the conversation.

(RPh 3100/Pt):

RPh: "Any questions or concerns?"

Pt: "No."

RPh: "Everything is good?"

Pt: "Everything is"

RPh "……..Any questions give us a shout."

2.6 Discussion

A combination of observations and think-aloud technique were used to characterize how pharmacists gather information and evaluate medication appropriateness in a community pharmacy setting.

Pharmacotherapy-Work Up

In Alberta, pharmacists are legally responsible for monitoring drug therapy and determining the appropriateness of each prescription they dispense.[86] In this study, all pharmacists checked if the medication was safe, but not all explicitly checked to see if the prescription was indicated, effective, safe, and manageable (i.e., adherence).

The prescription checks in this study were predominately technical and product focused (i.e., dispensing). Similarly, Albertan pharmacists have reported their roles to be mainly product focused.[72,73] Similar studies used indirect measure of PTW reported that the majority of the

pharmacists' time is devoted to dispensing medications,[87-89] and they allotted less than 11% to prescription monitoring and checking for appropriateness.[90,91]

Consultations

Pharmacists in this study discussed the medication's purpose, directions, and monitoring for less than 53% of all types of prescriptions. In consultations, pharmacists tend to be more focused on technical issues, as reported in several studies.[92-96] Emmerton and Jefferson found that a range of 17.6 – 46.9% of pharmacists' time is devoted to "professional" activities, while the rest is devoted to "business" and "non-productive" activities.[97] Similar studies reported that pharmacists spend less than 49% of their time on "professional activities".[90,91,98]

Pharmacists spent twice as much time on discussing clinical issues for new medications compared to refills (39% vs. 21%, respectively). Pharmacists discussed or queried the medication's purpose, directions, and monitoring for 71% of new medications, but did so for less than 36% of chronic refills. Previous studies reported similar findings; pharmacists asked patients clinical-related questions in 39% of new prescriptions compared to 26% for refills.[99] In a review study, pharmacists' counselling for new prescriptions varied from 29% to 69%.[100]

Qualitative Themes

Four overarching themes characterized the pharmacists' transcripts: *Missed opportunities, Depersonalized Assessments, Reliance on Routines* and *Nonspecific Questions*.

Missed Opportunities

This study suggests that pharmacists missed the opportunity to gather information or encourage the patient to participate. Yet, pharmacists often list a lack of patient information as a barrier to detecting drug related events.[49] Research in pharmacy and medicine suggests that pharmacists

need to engage patients in consultations not only by asking questions, but by phrasing questions in a way that encourages the patient to participate.[81,101]

Pharmacists' assumptions and their holistic assessments of prescriptions may represent intuition or automaticity in making decisions as described by Hoffman.[102] Intuition could explain why pharmacists in this study signed off prescriptions before making explicit assessing the four elements in the PTW. Intuitive thinking generates decisions automatically without effort and with low or no level of consciousness possibly represents a sign of expertise.[103] On the other hand, intuitive practice can lead to premature closure where decisions are made before verification or overconfidence bias: a tendency to believe that individuals know more than they do and act on incomplete information instead of carefully collected cues.[104]

Depersonalized Assessments

Pharmacists' reliance on patients' profiles rather than communicating with patients possibly resulted in pharmacists giving unsolicited information to patients. This tendency has been reported elsewhere.[81,105-107] In this study, pharmacists predominantly used close-ended questions as noted in the pharmacy literature since the 1990s.[51,99,108,109] Pharmacists focused on reviewing instructions on the vial and the common side effects rather than asking questions and making assessments.[110]

Reliance on Routines

In think-aloud data, pharmacists followed a routine check for safety and refill intervals and they were less likely to check for prescriptions indication and effectiveness. Reliance on technical dispensing routines may hinder pharmacists from detecting drug related problems related to patients' experience and consequently increase the rates of patients' morbidity and mortality, in addition to the huge economic burden on the healthcare system.[111-115]

Pharmacists did not routinely check appropriateness for refills in think-alouds. Pharmacists may have viewed refills as routines unless something changed about the prescription (e.g., dose increased). Witry reported that the routine nature of refills acts as a barrier for refill counselling,[92] and Guirguis and Lee reported that pharmacists believe they give priority to new patients or patients with new prescriptions.[77] Patients have also been found to be less interested in engaging in a dialogue about their refills when compared to first-time prescriptions.[116,117]

In previous studies, pharmacists reported a lack of time and workload as barriers for refill counselling.[92,106,118] Lack of time and store business did not appear to be the barrier as pharmacists in this study reported that their stores' busyness to be "steady" on average. This situation suggests that the routine nature of refills, not time pressures, to be the main barrier for failing to make a complete assessment for refills.[77,92]

Nonspecific Questions

Pharmacists tended to ask nonspecific questions (e.g., do you have any questions or concerns?) in place of more specific questions such as the 3PQs. While pharmacist are encouraged to start in an open manner, specific questions are required to monitor drug therapy Witry has suggested that pharmacists may perceive that they have insufficient information to ask more specific or meaningful questions.[110] Patients who experience depersonalized consultations may become disinterested in talking to their pharmacists about refills and prefer an automated prescription delivery system over a regular pick-up counter.[117]

The results of this study indicate that pharmacists tended to ask declarative (leading) questions or sometimes vague questions rather than asking the 3PQs in the form of open questions. Pharmacists want to appear knowledgeable about medications and thus ask declarative questions

to “save face”.[76] Nguyen suggested that declarative statement could function as a question where used by pharmacy interns who sought information about the purpose of the therapy.[105]

Future research on clinical decision making in pharmacy may benefit from a combination of prospective think-aloud and retrospective think-alouds to increase the depth and completeness of information collected as well as protocol analysis for a more inductive interpretation of pharmacists’ clinical decision making.[18] Ultimately, research should evaluate the link between pharmacists’ clinical decision making and patient outcomes. Pharmacists practice research should also investigation methods to address pharmacists’ bias toward new refills and reliance on technical routines.

2.6.1 Limitations

This study has a few limitations. First, the sample was insufficient to make generalizations about the findings beyond the participating pharmacists. In this study, pharmacists completed the think-aloud sessions with minimal real-world interruptions and were not prompted or guided by the researcher. However, a real-world setting may have introduced additional variability in data than in simulated studies.[102]

Think-aloud technique is prone to reactivity; pharmacists may perform better than usual because of a more structured working process or perform worse due to the double workload.[27,30] Think-aloud and consultation recordings are susceptible to one type of reactivity (i.e., the Hawthorne effect); where pharmacists or patients may have modified or improved their behaviours as they were aware they were recorded. If the Hawthorne effect played a role in the quality of this study’s results, pharmacists’ actual patient care process usually has fewer PTW elements than reported.

Another limitation was the incompleteness of verbal reports due to the absence of interviews or retrospective think-alouds. It was difficult to determine if pharmacists were using intuitive approaches or they simply stopped verbalizing their thoughts which may preclude definite conclusions. This study used audio-recordings and non-verbals were not captured. Finally, selection bias was a limitation in this study as pharmacists were responsible for the recruitment of patients from their practice, which may have led to bias within the sample.

2.7 Conclusions

Community pharmacists focused their attention on checking medication safety and providing information to patients with new prescriptions. Pharmacists gather insufficient clinical patient information to assess medication therapy as they relied on computer profiles, asked patients non-specific questions, and missed patient cues. Routine activities appeared to shape practice, including a bias against refills prescriptions and a focus on technical dispensing activities. Future research on pharmacists' assessment skills should attend to the role of routines and the physical environment on patient care in community pharmacies.

Table 2.1: Demographics and job characteristics of pharmacists

ID	Age range	Gender	Perception of store business	Years of practice	Work burnout[a] (mean, median)	Role conflict[b] (mean, median)
1100	< 25	Female	Slow with busy times	2	1.5, 1.5	3.3, 3.0
1200	36-45	Female	Slow with busy times	6	1.0, 1.0	4.0, 3.5
2100	25-35	Female	Slow	7	1.0,1.0	3.9, 3.0
2200	25-35	Male	Slow with busy times	6	1.5, 1.5	4.0, 4.0
3100	36-45	Female	Steady	14	1.5, 1.5	3.5, 3.0
4100	46-55	Female	Busy	29	0.5, 0.5	2.4, 3.0
4200	25-35	Female	Busy with slow times	7	4.0, 4.0	2.5, 2.5
5200	56-65	Female	Busy with slow times	40	0.5, 0.5	1.0, 1.0
5300	25-35	Male	Steady	4	2.0, 1.5	4.5, 5.0
			Mean± Std dev	12.8±13.0	1.5 ± 1.1 (median 1.5)	3.2 ± 1.1 (median 3)

[a] A 6 point Likert scale (0= Not at all, 1= Just a little, 2= A moderate amount, 3= Pretty much, 4= Quite a lot, and 5= A great deal)

[b] A 7 point Likert scale (1= very strongly disagree, 2= strongly disagree, 3= disagree 4= neutral 5= agree 6= strongly agree, and 7= very strongly agree)

Table 2.2: Incidence of pharmacists discussing 3PQs in consultations per prescription

	New Rx N= 7 (n/N%)	Prior Usage N= 14 (n/N%)	Total N= 21 (n/N%)
Incidence of PQ1 - Purpose	n=5 (71.4%)	0	n=5 (23.8%)
Incidence of PQ2 - Directions	n=6 (85.7%)	n=5 (35.7%)	n=11 (52.4%)
Incidence of PQ3 - Monitoring	n=6 (85.7%)	n=5 (35.7%)	n=11 (52.4%)
Proportion of Clinical Time[a]	38.9% ± 21.2 Min = 0, Max = 63.6%	20.9% ± 22.4 Min= 0, Max = 28.8%	27.2% ± 23.1 Min=0, Max= 63.3%
Proportion of Technical Time[b]	60.8% ± 21.1 Min=36.4%, Max= 99.5%	76.8% ± 24.6 Min= 34.8, Max = 99.9%	71.1% ± 24.1 Min=34.8, Max= 99.9%

Abbreviations used: PQ, prime question; Rx, prescription; Min, minimum; Max, maximum.

[a] *Clinical time: Moments where the pharmacist was discussing clinical issues with patients, such as asking about medical history, allergies, medication history.*

[b] *Technical time: Moments where the pharmacist was discussing technical aspects, such as insurance, social conversation, and paying the bill in consultation.*

Table 2.3: Incidence of pharmacists using PTW in think-alouds per prescription

	New Rx N= 7 (n/N%)	Refill (Prior Usage) N =13 (n/N%)	Total N= 20 (n/N%)
Incidence of PTW 1 - Indicated	n=1 (14.3%)	0	n=1 (5%)
Incidence of PTW 2 - Effective	n=3 (42.9%)	n=1 (9.1%)	n=4 (20%)
Incidence of PTW 3 – Safe	n=7 (100%)	n=13 (100%)	n=20 (100%)
Incidence of PTW 4 – Manageable	3 (42.9%)	8 (61.5%)	n=11 (55%)
Proportion of Clinical Time[a]	17.2% ± 3.6 Min= 15.1%, Max 22.5%	16.5% ± 10.1 Min= 2.5%, Max= 37.2%	16.4% ± 8.7 Min= 2.5%, Max 37.2%
Proportion of Technical Timeb[b]	74.2% ± 13.3 Min= 59.5%, Max=85.8%	83.0% ± 10.4 Min = 60, Max = 97.1%	80.6% ± 11.4 Min = 59.5%, Max= 97.1%

Abbreviations used: PTW, question to evaluate therapy; Rx, prescription; Min, minimum; Max, maximum.

[a] *Clinical time: Moments where the pharmacist was thinking aloud about clinical issues including PTW elements (e.g. checking for drug allergies, interactions, and refill history).*

[b] *Technical time: Moments where the pharmacist was thinking aloud about technical things (e.g. counting pills, labeling, and checking the prescriber's name).*

Table 2.4: Detailed description and qualitative themes for each audio recording.

RPh #	Pt #	Type of Rx	PTW1	PTW2	PTW3	PTW4	PQ1	PQ2	PQ3	Qualitative themes
1100	Pt1	Refill			X	X		X	X	Assumption, refill bias
	Pt2	New Rx		X	X	X	X	X	X	Assumption, profile & product focused, nonspecific questions
1200	Pt1	Refill			X	X			X	Refill bias, assumption, instinctive judgments, profile & product focused, refill bias, nonspecific questions
	Pt2	New Rx			X	X				Instinctive judgments, assumption, almost completely technical
2100	Pt1[a]	New Rx			X	X		X	X	Assumption, profile & product focused
2200	Pt1	Refill	n/a	n/a	n/a	n/a			X	Refill bias, nonspecific questions
	Pt2	Refill	X		X	X		X	X	Refill bias, assumption, nonspecific questions
	Pt3	Refill			X	X				Refill bias, instinctive judgments, profile & product focused, assumption, almost completely technical, nonspecific questions
3100	Pt1	Refill 1			X	X				Profile & product focused, assumption, almost completely technical , nonspecific questions
		Refill 2		X	X					
	Pt2	Refill 1			X	X				Profile & product focused, almost completely technical, nonspecific question, refill bias
		Refill 2			X	X				
4100	Pt1	New Rx 1			X		X	X	X	Profile & product focused, nonspecific question, assumption
		New Rx 2			X		X	X	X	
		New Rx 3			X		X	X	X	
4200	Pt1	Refill 1			X					Profile & product focused, nonspecific questions, almost completely technical
		Refill 2			X					
5200	Pt1	Refill			X			X		Assumption, profile & product focused, refill bias, almost completely technical
5300	Pt1	New Rx		X	X		X	X	X	Assumption, profile & product focused, nonspecific questions
	Pt2[a]	Refill1(dose adjusted)			X	X		X	X	Instinctive judgments, profile & product focused, refill bias, nonspecific questions
		Refill 2			X			X		

Abbreviations used: RPh, pharmacist; Pt, patient; Rx, Prescription; PQ, prime question; PTW, question to evaluate therapy.

[a] The only two cases where pharmacists asked PQs prior to think-aloud.

Table 2.5: Description of coded 3PQs and PTW and quotes.

Definition	Description of coded instances	Example
PTW1 Indication	RPh assesses if medication is indicated for individual patient (1 instance)	"so for the three medications that I am for her, I am checking last fill date to see if they were used appropriately, two of them are migraine medications and one is a nasal spray" (RPh 2200)
PTW2 Effective	Check against standard dose (3 instances)	"Patient is one year old given 125 mg of [amoxicillin] 3 times a day, familiar with it. That's a standard dose" (RPh 5300)
PTW3 Safe	All RPhs checked for safety (21 instances): drug interactions, allergies, and drug disease interactions on patient profile.	"check drug allergies, and then interactions, medical conditions." (RPh 4200)
PTW4 Manageable	Patients manage to take the medication' (10 instances)	
	-For refills, RPhs checked for patients' adherence with fill internals (7 instances)	"She got a 3 months or 90 day supply 89 days ago, so compliance is fabulous " (RPh 3100)
	For new prescriptions (3 instances), RPh added auxiliary labels to finish all or noted refills remaining.	"I will add an auxiliary label "finish all medication" (RPh 1100)
PQ1 Purpose	Leading questions (5 instances) (i.e., declarative) to verify indication	"Is it for a chest infection, throat infection...strep throat? Pt: Yeah." (RPh 1100)
	RPh giving information (1 instances)	"Doctor gave you something just in case if you develop yeast infection." (RPh 4100)
PQ2 Directions	Questions: (10 instances)	
	RPh asking closed questions (2 instances)	"But I think you are quite aware of how to use it right?" (RPh 2100)
	RPh asking "Did the doctor tell you?" (4 instances)	"Did the doctor give you specific instructions for how long? Pt: He just said to use it." (RPh 4100)
	RPh asking closed and open questions (1 instance)	"So do you just kind of alternate with these, or how do you use them" (RPh 2200)
	Pt asking questions (3 instances)	"RPh: Do have any questions or concerns? Pt: Yah, so since it is half way through the day, how does the three doses work" (RPh 5300)
	RPh giving information (8 instances)	"RPh 5200: So as before, one tablet one a day, swallow it whole. Pt: Um hum, um hum" (RPh 5200)
PQ3 Monitoring	Negative outcomes (i.e., adverse drug reactions) (8 instances)	
	RPh telling (6 instances)	"Now since the dose has increased, there is a possibility that you might have side effects because of the increase…" (RPh 5300)
	RPh asking closed (2 instances)	"Has he had any problems with, um, like weird muscle pain or muscle weakness…?" (RPh 2200)
	Positive outcomes of therapy (i.e., efficacy) (3 instances)	
	RPh telling (2 instances)	"Time frame, give it couple of days but really by the fourth or fifth dose you should notice an improvement in your symptoms." (RPh 1100)
	RPh asking closed questions (1 instance)	"Pt: Sometimes I don't take it every night. Yeah okay. Do you find you are completely sleepless when you do that?" (RPh 1200)

Abbreviations used: RPh, pharmacist; Pt, patient; PQ, prime question; PTW, question to evaluate therapy

Chapter Three

How Pharmacists Use the Patient Care Process to Check The Appropriateness of Medication Therapy? Simulations in Community Pharmacy

Mohammad B. Nusair, Lisa M. Guirguis

3.1 Abstract

Introduction: The patient care process is a clinical reasoning framework in which pharmacists ensure the most appropriate, effective and safe drug. This framework is well described in terms of the activities and responsibilities. However, research has not yet empirically characterized how pharmacists conduct this framework in community pharmacies.

Objective: The overall objective of this study is to characterize how pharmacists employ the patient care process when evaluating medication appropriateness in a simulated community pharmacy setting.

Methods: A mixed methods analysis was employed to analyze simulated patient-pharmacist interactions (i.e., consultations), and pharmacists thinking aloud sessions while evaluating medication therapy (i.e., concurrent think-aloud). Quantitative analysis was conducted using a codebook adapted from the patient care process. We also evaluated pharmacist and patient level of participation in consultations. This dataset was also reviewed and coded using generic qualitative approach.

Results: 17 pharmacists from eight different pharmacies in Metro Vancouver participated in this study. At prescription drop-off consultations, pharmacists were predominantly focused on collecting information to build a patient profile (e.g., demographics and medication history). Almost all pharmacists checked for medication indication, safety, and manageability, but this check primarily occurred at pick-up consultations. The majority of consultations were initiated and led by the pharmacist in a form of a monologue or dyad. Six overarching themes described consultations and concurrent think-aloud (CTA): missed opportunities, absence of personalized assessments, reliance on routines, nonspecific questions, communication style, and response to patient cues.

Conclusion: Overall, the majority of pharmacists completed most of the patient care process steps with minimal attention to medication effectiveness. The computer printout often played an important role in shaping therapy assessment to focus on drug–drug interactions and allergies. Moreover, pharmacists had opportunities to enhance patient-centred communication by engaging patients in dialogues and recognizing patient emotional cues.

3.2 Introduction

Pharmacists' roles have been expanding over time. Nowadays, community pharmacists are expected to engage a higher level of practice in order to improve patient outcomes and provide safe use of medications.[77,119] One approach to providing this level of care to patients in pharmacy is the patient care process (PCP).[46] This care process has been adopted to move community pharmacy practice from the traditional dispensing role to a more professional level of patient care.[2,119] The PCP is well described in terms of the activities and responsibilities. However, research has not yet empirically characterized how pharmacists conduct the PCP in community pharmacies. There are three major steps in the PCP: assessment of the patient's medical problem and drug therapies to identify drug therapy problems, care plan development, and follow-up evaluations.[46]

The identification of drug-related problems requires analyzing the sociological, pathophysiological, and pharmacological knowledge of the patient, disease, and drug therapy information, respectively.[46] This identification occurs in a logical, and systemic manner using pharmacotherapy work-up (PTW) during the assessment step of the PCP.[46] The PTW is a rational decision making process that assumes two sets of responsibilities. First, assurance that the patient's drug therapy is indicated, and the most effective, safest available, and most convenient option to be taken as indicated. Second, the duty to identify, resolve, and prevent drug related problems.[2,46]

In a pilot study, real-life consultations and a concurrent think-aloud were used to characterize how pharmacists gather information and evaluate medication appropriateness in a community pharmacy setting.[55] The data was analyzed using two elements of the Chat Check Chart (CCC) model:[77] 1) Chat—asking three prime questions to gather information.[75] This element is

analogous to eliciting medication experience in the assessment part of the PCP. 2) Check- adapted from PTW of the PCP by assessing prescription's indication, efficacy, safety, and manageability.[46,77] 3) Chart- documentation of the patient care using a recognized tool (i.e., DAP notes format).[77] The use of real world scenarios introduced variabilities in data and case complexity. Knowledge about patients' information (e.g., medication history) was not available and a few patients' medications or medical conditions could not be identified.[55] Therefore, a simulated patient was employed to resolve these limitations.

3.3 Objectives

The purpose of this study is to characterize how pharmacists employ the PCP when evaluating the appropriateness of medication therapy in community pharmacy settings. Specific objectives are 1) describe what elements of the PCP pharmacists use during patient consultations and when checking prescriptions and 2) characterize how pharmacists integrate the overall PCP into practice using the themes identified in the pilot study and identifying new themes that arose.

3.4 Methods

3.4.1 Research Design

This study employed an embedded concurrent mixed method design.[79] The converging of quantitative and qualitative thematic analyses allows for a thorough description of how pharmacists applied the PCP in a simulated case scenario. The data consists of concurrent think-aloud (CTA) and two types of consultations (i.e., prescription drop off and medication pick-up).

3.4.2 Sample

Participants in this study come from a larger study collected in September 2014 that aimed to evaluate the effectiveness of a training program designed to educate pharmacists on how to use

communication techniques. Pharmacy managers from a chain pharmacy in British Columbia were invited to participate in this study.

3.4.3 Procedure

One investigator (MBN) scheduled data collection at the pharmacists' convenience, informed the pharmacist of the study, and obtained informed consent.

3.4.3.1 Data collection and simulated case scenario

A simulated case scenario was designed to meet the objectives of this study; the simulated case had clear opportunities to check for PTW elements (Appendix 2). In order to avoid refill bias assessments,[55] the prescription in the simulated case was for a new medication for a chronic condition.

In this simulation, pharmacists were asked to accept the prescription from a new patient in a typical fashion (i.e., drop off). Pharmacists were then asked to check the prescription while verbalizing their thoughts (i.e., CTA). Following the CTA, a second interaction with the simulated patient occurred (i.e., pick-up). This interaction was designed to simulate the patient-pharmacist interaction during prescription pick-up. Patients interactions and the CTA were video recorded in a consultation rooms or a private office. Recordings were transcribed and checked for accuracy.

3.4.4 Data Analysis

Data was stored and organized using NVivo 11 Software.[120] It was analyzed using two different approaches: quantitative and qualitative.

3.4.4.1 Quantitative analysis

A quantitative codebook (Table 3.1) was adapted from the PCP.[46] The incidence of each PCP element was counted as it occurred or not (i.e., zero or one). Repeated incidences for the same prescription were not counted. The coded PCP elements in the consultations were later coded for patient-pharmacist level of participation (Table 3.1). For this level of analysis codes from MEDICODE, a validated coding grid for discussions of medications were adapted (Table 3.2).[121] An additional analysis described who initiated the PTW elements in consultations. When the pharmacist was the initiator, it was specified if it was in a form of eliciting or giving information.

3.4.4.2 Qualitative analysis

All transcripts (i.e., consultations and CTA) were analyzed using a generic qualitative approach.[56,78] Transcripts were reviewed and coded to describe how the pharmacists evaluated medication appropriateness and counseled patients. Two authors (MBN, LMG) reviewed the transcripts to get a sense of data and then identified themes that describe the PCP. Later, a detailed description of the themes and coding book guided the thematic analysis (Table 3.3). Relevant themes were adapted from the pilot study [55].

3.5 Results

A total of 17 pharmacists from Metro Vancouver participated in this study. All pharmacists were full-time community pharmacists practicing in one chain pharmacy with an average of 9.1 years of experience (Table 3.4).

3.5.1 Patient Care Process

Overall, no pharmacists checked all elements of the PCP in the three recordings combined; however, three pharmacists (RPh 102, 401, and 402) checked almost all elements (Table 3.5).

3.5.1.1 Consultations

Overall, pharmacists dedicated drop off consultations to elicit information (e.g., demographics) and build a patient profile (Table 3.1, Table 3.5). Pharmacists completed their assessments, provided care plan and follow-up evaluation in pick-ups. All pharmacists performed at least one assessment element in the two consultations Pharmacists elicited information to understand the patient's medication experience (i.e., past and current medication history) in drop off and pick consultations (Table 3.1). In pick-ups, all pharmacists discussed safety, and almost all discussed medication indication and manageability (Table 3.1). Five pharmacists discussed effectiveness in pickups. Some pharmacists did not assess any of the PTW elements in the drop off or CTA sessions (e.g., RPh 603), but they made almost complete assessments in the pick-up sessions. Similar to the PTW, the majority of care plan elements were identified in pick-ups (Table 3.1). However, pharmacists did not often schedule a follow-up with the simulated patient (Table 3.1). Nearly half of pharmacists invited the patient to call anytime for questions or concerns (i.e., provide continuous care; Table 3.1). Similar to the PTW findings, the majority of the follow-up evaluations was tailored to evaluate safety rather than effectiveness (Table 3.1).

Overall, pharmacists led the conversation and provided limited opportunities for sustained patient participation. At the drop-off consultations, pharmacists led dyads with occasional occurrence of dialogues (Table 3.5). Whereas in pick-up sessions, monologues and dyads were coded almost equally in PTW and care plan (Table 3.5). However, monologues were predominant in follow-up and evaluation (Table 3.5).

3.5.1.1 Concurrent think-aloud

All pharmacists verified if patient demographics on the computer printout (i.e., a hardcopy printout of all prescription and dispensing related information) matched the information the information they gathered from the patient (Table 3.5). Nearly all pharmacists checked for

prescription accuracy by reviewing the prescriber's information labelling of the dispensed vial, and identity of tablets (Table 3.1). Almost all pharmacists checked for medication safety by checking for allergies and potential drug-drug interactions (Table 3.5). Pharmacists sporadically checked for indication, effectiveness, and manageability (Table 3.5). At the end of CTA sessions, pharmacists signed the hardcopy and determined that the medication was ready for pick-up despite the fact many pharmacists had not gathered or review sufficient information to conduct the PTW.

The majority of the pharmacists checked most of the steps in the patient-care process in the complete process (i.e., drop-off, CTA, and pick-up) (Table 3.5). In total, almost all pharmacists checked for therapy indication, safety, and manageability; however, there fewer checked for effectiveness.

3.5.2 Thematic Analysis

Six overarching themes described how pharmacists communicated with the simulated patient and evaluated the prescribed medication (Table 3.3). Of the six overarching themes, four were adapted from our pilot study: *Missed Opportunities, Absence of Personalized Assessments, Reliance on Routines,* and *Nonspecific Questions.*[55] Two new overarching themes were identified in this study, *Communication Style,* and *Response to Patient Cues*.

3.5.2.1 Missed opportunities

This overarching theme was primarily but not strictly in CTA and included the following three sub-themes: *Assumptions, Instinctive Judgements*, and *It Is Common*.

Over half of pharmacists made assumptions (i.e., judgments using incomplete information) (Table 3.3) about safety issues, patient preferences, and medication indication. Pharmacists (RPh 102, 302 and 802) assumed that the medication was used to treat hypertension without overt

verification. RPh 302 asked the patient about his blood pressure before confirming if the patient had hypertension.

(RPh 302/SP)

RPh: "[patient name], how is your blood pressure at the moment?"

SP: "When I went to the doctor's office, the clinic today it was 120/70 so I was doing fine."

Assumptions were also made with other topics such as patient preferences and safety. Pharmacists' assumptions in regards to indication were correct. When pharmacists made inaccurate assumptions, the simulated patient corrected them (RPh 801 and 302).

(RPh 302/SP)

RPh: "With blood pressure medications, I see that you're not on any other ones. Sometimes in the beginning it can…[patient interrupts]"

SP: "Oh, I am taking another one."

RPh: "Okay."

At times in the CTA, pharmacists made *Instinctive Judgments* (i.e., assessments of medication without verbalizing). Pharmacists (RPh 101, 401, and 701) assessed medication appropriateness by saying something similar to "everything looks okay" (RPh 401). In one example, RPh 301 decided the medication seems fine: "there's nothing else that I would normally have to check off so that seems fine, I believe. Yeah".

It is Common was used when pharmacists made as a judgment based on what is commonly seen in practice. Some patient cues evoked patterns in the pharmacists' memory (i.e., pattern recognition) which guided them to a decision. Often "it is common" was seen after the simulated patient explained that he was switching from Ramipril to Candesartan "Did you get the dry

cough issue?" (RPh 302). One pharmacist expected that the patient was taking Lipitor at night since it is commonly taken at bed time: "so now are you taking your Lipitor in the evening, I guess", (RPh 102).

3.5.2.2 Reliance on routines

This included two sub-themes: *Hardcopy Check* and *Retail Related Routines*. Pharmacists had common routines in consultations and CTAs. The majority of pharmacists typically elicited information in a routine manner: verifying patient name, date of birth, health care card, contact information (address and phone number), allergies, and insurance.

For a *Hardcopy Chec*k, most all pharmacists followed a routine check in CTAs guided by the computer printout rather than patients' clinical experiences or outcomes. In one extreme example, RPh 801 only reviewed the computer printout.

> *RPh 801: "Second part here. Okay so [patient name], birthdate is [ah] November 9, 1983, address, he's a male, history, this is Dr. [doctor name]. Okay, license number, okay. Atacand 16 mg, Candesartan 16 mg, he needs three months, 90 tablets, 90 days, take one tablet once daily, okay, so no refills, no refills [pause]. Okay, the cost is 42, it doesn't have extended coverage. Okay [pause]."*

Retail-related routines theme was used to characterize how three pharmacists asked the patient if he has one or wants to apply for a customer loyalty card. Another form of retail-related routine was discussing payment method and mimicking how it to ring it through the till. At the end of drop offs, pharmacists made a habitual statement about waiting time. Some pharmacists made further reference to pharmacy busyness. "There are two people ahead of you right now so we are looking about 15 minutes or so" (RPh 401).

3.5.2.3 Absence of personalized assessments

This theme included two sub-themes: *Profile & Product Focused and Almost Completely Technical.*

Pharmacist were typically *Profile & Product Focused* during the CTAs. Pharmacists checked the patient profile information against the prescription and ensured the correct product was labeled properly. The majority of CTAs followed this similar pattern.

> *RPh 603: "Alright, so after verifying that the prescription has been typed correctly, of course we want to check the DIN, which we will verify and crosscheck against the bottle and of course, [hold the vial] check the physical product of the drug itself to make sure that it is indeed the correct medication. We would, I would typically open the stock bottle to verify the appearance of the medications as well and of course [looking at the vial], making sure that the label is correctly put on the vial."*

There was one exception where pharmacist 802 focused on making a personalized clinical assessment.

> *RPh 802: "I'm just looking at the customer himself. He's 30 years old, probably taking it for blood pressure. I'm just thinking he had said he'd never taken this before. I'm not sure if he's been on a different one before or if this is like his initial dosage for the medication at all. I mean if he's never had any blood pressure problems, medications before, [um]16 mg is usually a bit higher in terms of just starting, as a starting dose, [um]so it's something that you'd want to just double check with the patient on, usually. And but I mean the prescription is phrased correctly and ready for pickup, I guess."*

Over half of the drop off consultations were *Almost Completely Technical* where pharmacists did not discuss the prescribed medication or any other clinical information other than what was need

to create a new patient profile (e.g., allergies). RPh 603, however, only gathered clinical information at the drop off and did not elicit any demographic information. Pharmacist 801, however, discussed clinical and medication topics at the drop off with a technical focus at pick-up

3.5.2.4 Nonspecific questions

Pharmacists frequently used broad, general, or *Nonspecific Questions* to check for patient concerns or to elicit information. *Nonspecific Questions* included two types of questions or themes: *Did the Doctor Tell You Anything?* and *Any Questions?*

Did the Doctor Tell You Anything: Over half of pharmacists asked. "…did the doctor tell you anything about this?" (RPh 602). The simulated patient only provided information to open – ended requests. In some cases, pharmacists asked form of *Did the Doctor Tell You Anything* and followed-up with a more specific inquiry on medication indication or medication allergies. Pharmacists asked *Any Questions:* as part of a closing routine. When the simulated patient did not have questions, the pharmacists ended the consultation.

> *(RPh 801/SP)*
>
> *RPh: "Okay so your prescription is ready now and because you don't have any extended coverage, the total cost will be $42.29. Do you have any other questions?"*
>
> *SP: "No."*

3.5.2.5 Response to patient cues

Considered Patient Cues: Some pharmacists responded to simulated patient's cues. Three pharmacists noticed that the simulated patient was coughing during the consultations; "Okay and I hear you're coughing, is there any reason why?", (RPh 601). In one example, the pharmacist

noticed the simulated patient's hesitant body language and responded by asking, "Now do you have any hesitations?" (RPh 302). Another pharmacist noticed the simulated patient was discouraged about taking his blood pressure medication due to side effects.

A few other pharmacists *Missed Patient Cues*. Some pharmacists noted the cough, but neglected the resulting annoyance and embarrassment.

> *(RPh 701/SP):*
>
> *SP: "Because it's been so embarrassing for me for the past four weeks."*
>
> *RPh: "Yeah, now keep in mind the other medication that you're on that was causing the dry cough."*

3.5.2.6 Communication style

Two themes described the overall patient-pharmacist communication models consultations, a one-way process from pharmacist to patient *(i.e., Transmission),* and a two-way process where negotiations and discussion between pharmacist and patient occur (*i.e., Transactional)* [122,123]. We also identified two other themes that describes pharmacists' communication with patient, *Impersonal Greeting* and *Hesitancy.*

Many conversations at pick-ups were *transactional*. The nature of creating a new patient profile required a focused two-way conversation led by the pharmacist. While the majority of pharmacists involved patients in pick-up consultations, six pharmacists followed *Transmission* style. In this style, pharmacists overload the patient with large chunks of information. Sometimes this information was not tailored to patient needs and goals of therapy or disorganized (Box 1).

Pharmacists often demonstrated a pattern of *Impersonal Greetings* when they met the simulated patient. The majority of drop off consultation started with opening lines not far from the following example:

(RPh 301/SP):

SP: "Hi, I'm here to fill this prescription."

RPh: "Okay, is this prescription for yourself?"

SP: "Yes."

RPh: "Okay and have you had prescriptions at this location before?"

Two pharmacists demonstrated warmer greeting such as "Hi, how are you today", (RPh 602) and others introduced themselves (RPh 302, 402 and 603). One pharmacist started the drop off session with agenda setting, a question that allows patients to express their concerns [124]; "My name is [603], I'm the pharmacist here at [pharmacy name]. So first of all, did you have any questions or just here to drop off a prescription here?" (RPh 603).

At times, pharmacists expressed hesitancy or uncertainty by using "may be" or "probably". For example, "so it *may be* the right dose, it may not be. We won't know until you've tried it out for a week or two." (RPh 402). In some consultations, pharmacists' uncertainty made the simulated patient look hesitant about taking the medication "It usually has very, very minimal side effect for the cough. Still can happen but very, very small chance, but it's a good starting point for the medication and it's something that we do want to try out for you first" (RPh 302). In another example, RPh 702's uncertainty about the dry cough created the patient discomfort and led a medication switch.

3.6 Discussion

For this study, a mixed-method design characterized how pharmacists gather information and evaluate medication appropriateness using the PCP in a community pharmacy setting. In at least one recording, almost all pharmacists in this study conducted the following PCP: elicited patient's experience in regards to past and current medications, evaluated medication safety and manageability, and discussed goals of therapy and care plan interventions. Six overarching themes described how pharmacists evaluated the prescribed medication and consultations. The quantitative and qualitative findings can be integrated into three key findings: incomplete assessments, routines, and biomedical communication.

3.6.1 Incomplete Elicited Information and Assessments

Overall, most pharmacists ended the drop off consultations with insufficient information gathering to evaluate medication appropriateness. Therefore, CTAs were more focused on checking prescription accuracy, patient profile, and dispensed product; consequently, pharmacists signed off the prescription with little to no clinical information to make that decision. Pharmacists make a legal decision that the medication is appropriate when they sign it off. Yet, pharmacists in this study gathered information and made assessments regarding appropriateness. Pick-up consultations, on the other hand, were more clinical focused and pharmacists completed most of the PCP elements in these sessions. However, one would expect that pharmacists would gather enough clinical information before they proceed to CTA, and they would make a complete assessment before they sign off the prescription and start the pick-up session. A previous study reports using similar overall content in counselling.[125] They also reported that follow-up evaluations were brief and vague.[125]

These missed opportunities do not necessarily suggest that pharmacists lack the knowledge and training to provide this level of patient care. It is possible that pharmacists relied on intuition or pattern recognition represented by the themes assumptions, instinctive judgments, and it is common. Clinical reasoning studies in health care have implied that experienced clinicians employ intuitive reasoning to solve clinical problems.[103,104] However, relying on intuition based on assumptions or pattern matching may limit information-gathering to only confirmatory data, thus causing the pharmacists to miss other opportunities. It is important to be cautious about making assumptions though, as patients reported being frustrated at not receiving enough information from their pharmacists.[126]

It is also possible that these missed opportunities are due to pharmacists' distraction with dispensing related activities rather than professional and clinical activities.[55,91,98] Therefore, pharmacists should rely more on pharmacy technicians; pharmacy technicians can ensure that prescriptions are authentic and complete, ensure the accuracy of a prepared prescription, and perform a final check of the dispended product.[127]

3.6.2 Routines

In this study, pharmacists relied heavily on a computer printout to check for medication appropriateness in CTA. Pharmacists checked for safety elements (i.e., allergies and drug interactions), as these elements were available on the printout. Other, less readily available PTW elements were less likely to be evaluated. A similar routine theme was also reported in our pilot study and in Montgomery et. al..[55,125] This suggests that pharmacists' reliance on computer printouts has created a routine that limited pharmacists' assessments.

Pharmacists also had another counselling routine characterized by conducting the majority of PCP in pick-ups. This routine provides one explanation for the vast numbers of undetected drug-

related problems, as pharmacists do not always have the opportunity to counsel patients at medication pick-up. Therefore, it is important that pharmacists make a complete assessment when they have the opportunity to counsel the patient, and not assume that they will be conducting a second consultation at the pick-up.

Furthermore, retails-related routines such as referral to loyalty cards or payment for medications have become a habitual part of pharmacist practice. One would expect such routines in a real-world setting;[55] however, it was interesting to capture such routines in this study, particularly in the think-aloud recordings, as it was a simulation and there was neither a computer reminder nor a billing transaction. Some of these routines (e.g., loyalty program cards) can be recognized as a social desirability bias. This bias refers to participants' tendency to report socially desirable responses possibly in a favourable light to the researcher or others (i.e., impression management).[128,129] There were other instances that suggest this bias, "My name is [RPh 302], I'm the pharmacy manager here, so we always like to welcome new patients with a smile", (RPh 302). Social desirability could also result in depersonalized consultations and possibly providing unsolicited information "In terms of storage, keep this tightly capped, keep this [holding vial] in an area away from direct heat or direct sunlight and in a low humidity place, so like a kitchen cupboard", (RPh 402). The latter example of social desirability was possibly reported because of pharmacists' familiarity of necessary counseling information in licensing exams. This does not necessarily occur in their daily practice.

3.6.3 Biomedical Communication

The literature of patient-pharmacist interactions identified two communication models, patient-centred and biomedical.[122,123] In the latter, pharmacists concentrate on providing mediation-related information in a transmission action. Whereas, in a patient-centered commutation

pharmacists involve patients in consultations, and actively listen to patients to identify and respond to their emotions and cues.[123,130] In study, pharmacists often showed biomedical communication by not involving the patient in dialogues or responding to his cues.

The drop-off sessions in this study were transactional due to the nature of these sessions as pharmacists needed to elicit information to create a new patient profile. However, this finding does not necessarily suggest that drop offs were patient-centered interaction. In a patient-pharmacist collaboration, pharmacists would identify treatment goals, assess the appropriateness of medication therapy, ensure patients have an understanding of their medication therapy, and monitor symptoms and evaluate outcomes.[122,131,132] Similarly, pick-up consultations were often dyadic and transactional; however, pharmacists often used monologues in follow-up evaluation plans and a mix of dyad and monologues when discussed PTW elements.

Pharmacists demonstrated active listening and responded to some cues; however, they seemed to miss opportunities to be empathic and respond to the patient's cues. It is not sufficient to just identify patients' cues; pharmacists need to demonstrate an understanding of what patients think or feel about a situation in order to make patients more comfortable with sharing information.[123] These empathic opportunities were hints of worry or concern, or clear expressions of worry.[133,134] The literature of patient-clinician communication highlights that these types of cues are a challenge for most health care professionals, and are a constant issue in patient-clinician communication interactions.[135-137] We also noted that pharmacists did not often introduce themselves nor warmly greeted the patient; Montgomery et al., reported similar findings.[125] On several occasions, pharmacists asked the simulated patient nonspecific questions such as "did the doctor tell you anything?". Specific and open-ended questions are more likely to invite patients to be actively involved in consultations.[75,105] The use of nonspecific and closed questions

may suggest that pharmacists have insufficient information,[110] which could possibly result in less patient-tailored information and personalized assessments, [55] and may discourage patients from talking to their pharmacists when returning for refills or new medications.[117] Furthermore, pharmacists in this study had a habitual reliance on nonspecific questions (i.e., any questions theme) to end consultations. Eliciting patient's concerns in regards to therapy is one of the main elements of the PCP; the questions need to be phrased in a way that encourage the patient to participate.[81,101]

3.6.4 Limitations

First, this study involved small sample size practicing in one chain pharmacy and one geographical area. Thus, findings are not generalizable to other pharmacists. Second, this study employed clinical simulation, so there was an incomplete representation of real patients and settings. Furthermore, concurrent think-alouds have drawbacks. First, participants may perform better or worse than usual (i.e., reactivity).[27,30] The Hawthorne effect may have modified pharmacists' behavior on a few occasions where reported activities that they did not conduct. Moreover, social desirability bias also modified some pharmacists' behaviors such as retail-related routines (e.g., loyalty program cards). Despite this potential reactivity, pharmacists did not make complete the PCP. This suggests that pharmacists' routine practice had more opportunities for improvement.

3.6.5 Implications

Future research should explore if pharmacists' reliance on technical and retail-related routines is hindering them from applying clinical knowledge and expertise. Moreover, future research should address methods to shift pharmacists toward achieving transactional consultations and involving patients more often in clinical dialogues. Research should also investigate methods to

encourage pharmacists to achieve warm greetings, be more empathetic, respond to patient cues, and ultimately achieve patient-centered communication.

Regulated pharmacy technicians could perform technical tasks and pharmacists could devote their time to evaluating medication therapy. Furthermore, this study highlights the need to investigate pharmacists' clinical decision when they legally sign off prescriptions; it is important to understand the type of information pharmacists elicit and assess to make a legal decision regarding medication appropriateness.

3.7 Conclusions

Overall, the majority of pharmacists completed most of the patient-care process steps. Most of these steps were completed in the pick-up consultations, whereas the drop-off consultations and CTA were mainly devoted to dispensing activities. This study also suggests that pharmacists expressed intuition and pattern recognition when they evaluated therapy and counseled the patient. The computer printout often played an important role in shaping therapy assessment to focus on drug–drug interactions and allergies. Pharmacists had opportunities to enhance patient-centred communication by engaging patients in dialogues and recognizing patient emotional cue.

Table 3.1: Patient care process elements, definitions, and incidence of pharmacists employing these elements in all recordings

Patient care process elements	Definitions	Drop off	Concurrent think-aloud	Pick-up	Overall
1. Assessment		17	17	17	17
1.1 Meeting the patient	Instances that refer to pharmacists introducing themselves, or greeting the patient.	5	N/A	2	6
1.2 Eliciting information from the patient		17		17	17
1.2.1 Reason for the encounter	This code refers to patient's primary reason for going to the pharmacy or seeking help. This could be achieved by asking the patient to tell their story. *e.g., "what can I do for you today"*	3		0	3
1.2.2 Patient Demographics	Instances that refer to patient's age, gender, address, contact info, and living situation (e.g., insurance). *e.g. "Alright, I just need to verify identification and birth date November 9, 1983?"*	16		3	16
1.2.3 Understanding the patient's medication experience		17		17	17
1.2.3.1 Patient concerns and needs	Instances that refer to pharmacists gathering information from patient to assess what they understand about their current therapy, needs, concerns. *e.g. "do you have any question about your mediation?"*	6		17	17
1.2.3.2 Past and current medication history	Instances that refer to pharmacists gathering information from patient about current or past medications, over the counter and herbal, reason for	17		16	17

Patient care process elements	Definitions	Drop off	Concurrent think-aloud	Pick-up	Overall
	taking them, directions, allergies, and adverse drug reactions. This code also social drug use (e.g., tobacco, alcohol). *e.g. "have you had any heart medication before or blood pressure medication before in the past?"* *e.g. "did the doctor tell you much about your medication at all"*				
1.2.4 Clinical information	Instances that refer to pharmacists gathering information from patient past and current medical history, vital signs (e.g., blood pressure), and lab tests. *e.g. "did he tell you what your blood pressure is"*	7		7	7
1.3 Pharmacotherapy workup	Instances that refer to pharmacists making an assessment of the pharmacotherapy workup elements in the consultations or think-aloud sessions. This code differs from eliciting information codes in 1.2.	9	15	17	17
1.3.1 Indication	Instances that refer to pharmacists making an assessment if the medication is indicated for the medical condition and/or the patient, or if the pharmacists have any doubts about the medication. This may also include checking for unnecessary drug therapy (e.g., duplicate therapy or no medical indication) *e.g. " so this to help to reduce your blood pressure and replace your Altace"*	8	2	15	15
1.3.2 Effectiveness	Effectiveness (PTW_E): Instances that refer to pharmacists making an assessment if the medication is going to be effective, or if the dose is effective for the medical condition it was prescribed for. Effectiveness in our simulated case can also be evaluated by assessing how Ramipril has been working for the patient since the patient is switching from Ramipril to Candesartan	0	2	5	5

Patient care process elements	Definitions	Drop off	Concurrent think-aloud	Pick-up	Overall
	e.g. "so you should have similar effects in terms of blood pressure lowering results"				
1.3.3 Safety	Instances that refer to pharmacists making an assessment is going to be safe for the patient. This may include evaluating allergies to prescribed medication, contraindications, drug-drug or Drug – disease interactions, misuse, safe dose or overdose. e.g. "because it is new I will always look for any drug interactions and just to make sure everything is going okay for you"	2	15	17	17
1.3.4 Manageability	Instances that refer to pharmacists making an assessment use/ adherence to therapy, this may include: a) evaluating if the patient is willing to take the correct dosage or following instructions for taking the medication in question, and b) evaluating patient's understanding or preference for instructions and directions to take their medication e.g. "so I would recommend just keeping it at the same time as the Altace that you have been taking before, so just one tablet once a day in the morning. It does not matter if it is before eating or after eating. There is no restriction on any diet or anything like that. Okay?"	1	7	16	16
2. Care Plan		9	2	17	17
2.1 Goals of therapy and desired outcome	Instances that refer to a discussion of the goal of therapy, positive outcomes, resolve drug related problem, reduction of symptoms. In this case we expect a discussion related to blood pressure control and resolve cough. e.g. "So hopefully when you start to take this, you won't…the cough will go away. It might take a little while, it won't be instantaneous but I would say, you know, hopefully you'll notice a difference	0	0	16	16

Patient care process elements	Definitions	Drop off	Concurrent think-aloud	Pick-up	Overall
2.2 Determine interventions	Instances that refer to a discussion of an intervention to a) resolve and prevent DRP, and b) achieve goals including; patient education, a monitoring plan e.g. "but if you experience any of that, monitor your blood pressure" e.g. "I want to make sure that you keep monitoring your blood pressure more frequently the next week or two"	8	2	17	17
2.3 Schedule a follow-up	Instances that refer to one of the following: when should the follow up evaluation be scheduled to evaluate appropriateness of therapy. e.g. "I will call you in about a week's time and then we will just touch base and make sure that everything is going as planned"	1	1	5	5
3. Follow up Evaluation		4	-	11	11
3.1 Follow up to evaluate effectiveness	Instances that make reference to evaluating effectiveness of care plan in the next follow up. e.g. "so there is a one supply in here so as I said if it is okay, your blood pressure is all good then just continue taking it"	1	-	5	5
3.2 Follow up to evaluate safety	Instances that make reference to making reference to evaluating safety of care plan in the next follow up. e.g. "so then if it seems to be not a problem, then the next time you have it filled you can complete the rest of the prescription so you can have the other 60 filled"	3	-	8	8

Patient care process elements	Definitions	Drop off	Concurrent think-aloud	Pick-up	Overall
3.3 Assess any new problem and make changes to care plan	Instances that make reference to making to assessing any new possible drug related problem on the next follow up and make changes to care plan accordingly. e.g. " then definitely let the doctor or myself know as well, it might be that the dose of the medication is a little bit high and we might have to adjust the medication"	1	-	2	2
3.4 Provide continuous care	Instances that make reference to inviting the patient to contact pharmacist at any time not necessarily on the next refill or follow up. e.g. " well feel free to contact me, I am available in the pharmacy the phone is right on the label there so if you have any questions or concerns feel free to contact us"	1	-	8	8

Table 3.2: Level of participation

Level of Participation	Definition
Monologue	Instances when pharmacist is the only one who discusses the PCP element and the patient does not participate.[121]
Dyad	Assigned for instances when pharmacist and patient speak about one particular PCP element, however, patient responses to what the pharmacist said.[121]
Dialogue	Assigned for instances when the patient gets more than two turns to talk about the same subject. There is no particular length to patient's participation in dyad and dialogue; it could be lengthy with comments or brief.[121]

Table 3.3: Overarching and corresponding subthemes, definitions, and occurrence in each type of recording.

Overarching Theme	*Subtheme*	Definition	Number of themes coded		
			Drop off	**Concurrent think-aloud**	**Pick up**
Missed Opportunities	***Assumptions (n=9)***	Pharmacists checked for prescription appropriateness using incomplete information and acted on assumptions.	2	4	3
	Instinctive Judgements (n= 6)	Instances where pharmacists made an assessment of prescriptions instinctively without verbalizing their thoughts. "everything looks good" or "looks fine"	n/a	6	n/a
	It is common (n=7)	Instances in which pharmacists made judgements based on what is commonly seen in practice.	3	n/a	4
Absence of Personalized Assessments	***Profile & Product Focused (n=14)***	Pharmacists were more focused on verifying patient demographics and non-clinical background information.	n/a	14	n/a
	Almost Completely Technical (n=11)	. Consultations that were completely technical and pharmacists discussed little to no clinical information with the patient.	10	n/a	1
Reliance on Routine Pharmacist Activities	***Hardcopy Check (n=15)***	Pharmacists assessed appropriateness in a routine manner focusing on the computer printout elements rather than patients' clinical experiences or outcomes; e.g., items related to interactions, allergies, and refill intervals.	n/a	15	n/a
	Retail-related routines (n=13)	Instances where pharmacists checked for reward cards that were issued by the pharmacy corporate or discuss paying for the medication and ringing it though the till.	6	1	6

Nonspecific Questions	***Any Questions? (n=20)***	Nonspecific questions to elicit patient medication experience and knowledge. (e.g., any questions? Or concerns?)	5	n/a	15
	Did the doctor tell you anything? (n=12)	Pharmacists asking the patient a broad question about what the doctor told him about the prescribed medication.	8	n/a	4
Patient Cues	***Considered patient cues (n=6)***	Instances in which pharmacists capture patient's verbal or nonverbal cues and respond to them.	-	n/a	6
	Missed Patient Cues (n=3)	Instances where pharmacists missed some of the patients' cues that indicated their confusion, uncertainty, or hesitation about their medications; these cues could be inferred from their tone of voice or behaviours	-	n/a	3
Communication style	***Transmission (n=6)***	One-way conversations where pharmacists focus on providing information with limited patient contribution.	-	n/a	6
	Transaction (n=28)	Two-way consultations in which both pharmacists and patient discuss information and outcomes.	17	n/a	11

Table 3.4: Participant Pharmacists' Demographics

RPh ID	Gender	Age [a]	Years of experience [a]		Store busyness
101	M	28	3	Full time	Busy
102	F	55	33	Full time	Busy
201	F	38	16	Full time	Busy with slow times
202	F	26	8	Full time	Busy with slow times
301	F	32	3	Full time	Busy with slow times
302	M	29	10	Full time	Busy
401	M	36	9	Full time	Steady
402	M	27	4	Full time	Slow with busy times
501	M	32	2	Full time	Slow with busy times
502	F	28	1	Full time	Slow with busy times
601	F	37	13	Full time	Steady
602	F	32	9	Full time	Busy with slow times
603	M	26	2	Full time	Steady
701	M	40	17	Full time	Busy with slow times
702	F	33	9	Full time	Busy with slow times
801	M	37	4	Full time	Busy
802	F	32	9	Full time	Busy with slow times
	Mean ± Std dev	33.4 ± 7.1	9.1 ± 7.5		

Abbreviations used: RPh, pharmacist; M, male; F, female; Std dev, standard deviation.

[a] Calculated at the data collection year (2014)

Table 3.5: Detailed use of patient care process elements for each pharmacist

Assessment Elicit Info		101	102	201	202	301	302	401	402	501	502	601	602	603	701	702	801	802
Drop Off	**Meet Patient**	X					X	X	X					X				
	Demographics	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}		X^{d}	X^{d}	X^{d}	X^{d}
	Medication History	X^{c}	X^{d}	X^{d}	X^{d}	X^{c}	$X^{c,d}$	$X^{c,d}$	$X^{c,d}$	X^{c}	$X^{c,d}$	X^{d}	X^{c}	X^{c}	$X^{c,d}$	$X^{c,d}$	$X^{c,m}$	X^{c}
	Clinical Info						X^{c}	X^{d}	X^{d}	X^{d}	X^{d}			X^{d}			X^{d}	
	Patient Needs	X^{d}	X^{d}					X^{d}				X^{d}	X^{d}					X^{d}
Think Aloud								**-n/a**										
Pick Up	**Meet Patient**							X			X							
	Demographics											X^{d}	X^{d}			X^{d}		
	Medication History	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	$X^{c,d}$	X^{d}	$X^{c,d}$	$X^{c,d}$	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}		$X^{c,d}$
	Clinical Info				X^{d}		X^{c}		X^{d}			X^{d}	X^{d}	X^{d}				X^{d}
	Patient Needs	X^{d}	X^{c}	X^{d}	X^{d}	X^{d}	X^{d}	X^{d}	$X^{c,d}$	X^{d}	X^{d}	X^{d}	X^{d}	$X^{c,d}$	X^{d}	X^{d}	X^{d}	X^{d}
Pharmacotherapy Work-up		101	102	201	202	301	302	401	402	501	502	601	602	603	701	702	801	802
Drop Off	**1-Indication**		$X^{a,d}$		$X^{b,d}$		$X^{p,c}$		$X^{b,d}$	$X^{b,d}$	$X^{b,d}$					$X^{a,m}$	$X^{b,d}$	
	2-Effectiveness																	
	3-Safe							$X^{a,d}$									$X^{a,b,c}$	
	4-Managablity																$X^{a,m}$	
Think Aloud	**1-Indication**															X		X
	2-Effectiveness					X			X									
	3-Safe	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X
	4-Managablity		X				X											X
Pick Up	**1-Indication**	$X^{a,m}$	$X^{a,m}$	$X^{b,d}$	$X^{a,m}$	$X^{b,d}$	$X^{a,m}$	$X^{a,m}$	$X^{a,m}$	$X^{a,m}$	$X^{a,m}$	$X^{a,b,d,m}$	$X^{a,b,d,m}$	$X^{a,b,d,m}$	$X^{b,d}$	$X^{p,m}$		
	2-Effectiveness		$X^{a,m}$		$X^{a,m}$				$X^{a,m}$			$X^{a,b,m,d}$			$X^{a,m}$			
	3-Safe	$X^{a,m}$	$X^{a,d,m}$	$X^{a,m}$	$X^{a,m}$	$X^{a,d,m}$	$X^{a,d}$	$X^{a,m}$	$X^{a,d}$	$X^{a,m}$	$X^{a,d}$	$X^{a,d,m}$	$X^{a,m}$	$X^{a,d,m}$	$X^{a,d}$	$X^{a,d,m}$	$X^{a,m}$	$X^{a,m}$
	4-Managablity	$X^{a,d}$	$X^{a,b,m,d}$	$X^{a,m}$	$X^{a,m,d}$	$X^{a,m,d}$	$X^{a,m,d}$	$X^{a,d}$	$X^{a,d}$	$X^{a,m}$	$X^{a,d}$	$X^{a,m}$	$X^{a,b,d}$	$X^{a,m}$	$X^{a,d}$	$X^{a,m}$		$X^{a,d}$

	Care Plan	101	102	201	202	301	302	401	402	501	502	601	602	603	701	702	801	802
Drop Off	Goals of therapy																	
	Determine interventions		X^{d}	X^{c}		X^{d}				X^{d}		X^{d}			X^{d}	X^{d}	X^{d}	
	Plan a follow-up									X^{d}								
Think Aloud	Goals of therapy																	
	Determine interventions		X							X								
	Plan a follow-up									X								
Pick Up	Goals of therapy	$X^{m,d}$	$X^{m,c}$	$X^{m,d}$	X^{m}	X^{m}	X^{d}	X^{d}	$X^{m,d}$	$X^{m,d}$	$X^{m,d}$	X^{m}	$X^{m,d}$	X^{m}	X^{d}	$X^{m,c}$		$X^{m,d}$
	Plan interventions	$X^{m,d}$	$X^{m,d}$	$X^{m,d}$	$X^{m,d}$	$X^{m,d}$	$X^{m,d}$	$X^{c,d}$	$X^{c,d,m}$	$X^{c,d,m}$	$X^{d,m}$	$X^{d,m}$	X^{d}	$X^{c,d,m}$	$X^{d,m}$	$X^{c,d,m}$	X^{c}	X^{m}
	Plan a follow-up				X^{d}			$X^{d,m}$		$X^{d,m}$			$X^{d,m}$		X^{d}			
Follow-up		101	102	201	202	301	302	401	402	501	502	601	602	603	701	702	801	802
Drop Off	Evaluate effect			X^{d}														
	Evaluate safety		X^{d}	X^{d}						X^{d}								
	Change plan																X^{d}	
	Provide cont. care																	
Think Aloud n/a																		
Pick Up	Evaluate effect		X^{m}						X^{m}	X^{m}	X^{m}	X^{d}						
	Evaluate safety		X^{m}					X^{m}	$X^{m,d}$	X^{m}	X^{m}	$X^{m,d}$	X^{m}		X^{d}			
	Change plan		X^{m}						X^{m}									
	Provide cont. care	X^{d}	X^{m}	X^{d}				X^{m}	X^{m}		X^{m}		X^{m}	X^{m}				

[a] Pharmacist telling patient about the PTW element, [b] Pharmacist eliciting information regarding PTW element, [p] Patient gives info, [M] Monologue, [D] Dyad, [C] Co-production

Table 3.5: Detailed use of qualitative themes for each pharmacist.

Themes		101	102	201	202	301	302	401	402	501	502	601	602	603	701	702	801	802
Absence of Personalized Assessments	**Almost Completely Technical**	X	X	X	X	X						X	X		X	X	X	X
	Profile and product focused	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Nonspecific Question	**Any Question**		X	X		X	X	X	X				X	X	X	X	X	
	Did the doctor tell you anything	X	X		X		X	X	X	X			X		X			
	Nonspecific follow-up	X		X				X	X				X	X				
Patient Cues	**Acknowledging and reflecting to patient cues**		X				X			X		X			X			
	Missed patient cues										X			X	X			
Missed Opportunity	**Assumption**	X	X	X	X	X	X										X	X
	It is common		X	X			X			X	X							X
	Instinctive judgment	X	X			X		X						X	X			
Reliance on Routine Pharmacist Activity	**Hardcopy check**	X	X	X	X	X	X	X	X		X	X	X	X	X		X	
	Retail-related routine		X					X				X	X		X	X	X	
Communication Style	**Transaction**	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Transmission					X	X		X	X		X				X		
	Impersonal Greetings	X	X	X	X	X				X	X	X			X	X	X	

Chapter Four

Using Protocol Analysis to Describe Community Pharmacists'

Clinical Reasoning

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4.1 Abstract

Introduction: Pharmacists' regularly make decisions to determine medication appropriateness and identify and manage drug-related problems. It is important to develop an initial understanding of the clinical reasoning pharmacists currently use in their daily practices. The literature of clinical reasoning and cognitive psychology identifies two fundamental approaches to reasoning, intuitive (i.e., system 1) and analytical (i.e., system 2). These systems have yet to be well described in the pharmacy literature. We used protocol analysis for the two types of verbal reports to provide descriptions of clinical reasoning in depth.

Objective: The overall objective of this study is to describe pharmacists' clinical reasoning when checking for medication appropriateness using protocol analysis.

Methods: In this study, we used a simulated case scenario for data gathering. We collected two types of verbal reports, concurrent think-aloud (CTA) and structured retrospective think-aloud (RTA). The CTA data was collected by having pharmacists think out loud as they evaluated medication appropriateness whereas the structured RTA data was collected in an interview immediately after the simulated case. All verbal reports were video-recorded and later transcribed.

Results: A total of 17 pharmacists from eight different pharmacies participated in this study. In the CTA data, the majority of pharmacists used system 2 reasoning. In structured RTA, pharmacists reported "overlooked" decisions and restructured decisions that did not appear in the simulation and CTA sessions. System 2 (i.e., forward-chaining) was the most common reasoning both CTA and structured RTA sessions. We also identified clinical reasoning approaches that were not identified in pharmacy studies before (i.e., automaticity, if/then, and dual process theory).

Conclusion: Overall, the majority of pharmacists used system 2 to make decisions and system 1 was occasionally identified. The findings of the structured RTA data suggest that pharmacists used their knowledge and experience to provide hindsight reasoning. This study highlighted the significance of protocol analysis to study clinical reasoning as well as, retrospective protocols to expand the description of clinical reasoning.

4.2 Introduction

Pharmacists' responsibilities to provide patient care are no longer limited to the technical activities of dispensing and packaging a prescribed drug.[138] Since the pharmacy profession has adopted the concept of pharmaceutical care, there has been an increased demand for pharmacists to improve patient outcomes and reduce medication errors.[139] With increased numbers of medication usage and polypharmacy, pharmacists have a key role to ensure the safest and most effective use of medication.[139,140] Pharmacists are constantly required to check for medication appropriateness, monitor drug therapy, and resolve drug-related problems during routine encounters with patients in a community pharmacy setting. However, the prevalence of preventable drug-related problems underscores the number of opportunities that pharmacists have to make decisions regarding medication appropriateness.[4] The underlying thinking processes that pharmacists use to determine medication appropriateness and identify and manage drug-related problems is called clinical reasoning.[141,142] Understanding pharmacists' clinical reasoning is essential to ultimately preventing drug-related problems. Pharmacists, however, are still viewed as dispensers rather than clinical experts who can make clinical decisions, and they feel reluctant to make such decisions.[143] There is limited information as to whether pharmacists are regularly making these clinical decisions in routine encounters and how these decisions are being made. Therefore, there is a need to understand pharmacists' clinical reasoning when they make decisions regarding medication appropriateness.

Clinical reasoning is defined as the cognitive process through which practitioners apply their knowledge and clinical experience to assess and manage patients' medical problems.[9,10] In clinical reasoning, pharmacists solve problems and make decisions by collecting, verifying and assessing information (i.e., concepts) while checking for mediation appropriateness. The actions

pharmacists take to move from one concept to another are called operators.[29] These operators are essential to describe the clinical reasoning process. In order to be able to describe clinical reasoning at this cognitive level, verbal reports and qualitative analysis methods guided by information-process theory are required.[29] The verbal reports provide an accurate reflection of short-term memory and the information that is being processed at the time of problem-solving or decision-making. According to information-processing theory, this is exactly what is needed to understand pharmacists' clinical reasoning processes.

The literature of clinical reasoning and cognitive psychology identified two fundamental approaches to reasoning: intuitive, or heuristic (i.e., system 1); and analytical (i.e., system 2).[103,144-150] System 1 reasoning requires little mental effort with clinicians acting on assumptions, feelings, or hunches in a nonlinear fashion (i.e., intuition). This system can also be characterized as quick, automatic, and internalized (i.e., automaticity).[102,151] Decisions made under this system could also be consciously or subconsciously influenced by matching patient or illness characteristics to past exemplars (i.e., pattern recognition).[102,152,153]

In contrast to system 1, system 2 reasoning is analytical, systematic, and slow, requiring higher levels of mental awareness and effort.[103,149,154] The hypothetico-deductive approach is the most common analytical approach described in clinical reasoning. It is a systematic process that involves acquiring data and then interpreting it to generate and evaluate a hypothesis.[155-158] Forward-chaining reasoning is a form reasoning in which data is analyzed to generate a hypothesis or diagnosis (i.e., data →hypothesis),[159,160] whereas a deductive reasoning starts with a hypothesis and involves the use or analysis of data to test whether the hypothesis is correct or incorrect (i.e., data ←hypothesis).[157,160] In some cases, decisions are made by linking particular evidence with the conclusion in an if/then approach. The if/then approach may represent basic

hypothetico-deductive thinking that is simplified by using fewer operators and a logical reasoning. We therefore classified if/then approach as a form of system 2 reasoning.

Systems 1 and 2 are not always mutually exclusive, as both systems can be employed jointly to make decisions. This dichotomous approach has been recognized in both psychology and clinical reasoning literature has been defined as the dual process theory.[144,145,149,150]

A small number of studies have been done to describe pharmacists' clinical reasoning.[48-53] We identified three studies that explored pharmacists' diagnostic reasoning using think-aloud protocol.[48,51,52] Overall, these studies do not reveal that pharmacists incorporate a clear approach for reasoning.[48,51,52] A recent study suggested that pharmacists show a pattern of excuse-making demonstrated by educating their patients and building strong relationships with them rather than using actual clinical reasoning.[50] However, other suggested forward-reasoning approach to make implicit deductions and validate hypotheses,[49] as well as recognition of common patterns to make decisions.[49,52] These studies describe pharmacists' clinical reasoning; however, because of the way in which verbal reports are collected, they are limited. In particular, by involving the think-aloud process while interacting with simulated patient, the reported thoughts and behaviors may not accurately reflect on-the-job clinical reasoning of the pharmacists. In addition, the aforementioned studies use mainly thematic analysis of the verbal reports, which is insufficient to examine pharmacists' clinical reasoning in depth. Thematic analysis offers a description of overall clinical reasoning in the social and practical context, but it does not describe how clinical reasoning actually takes place at the cognitive level with concepts and operators.

Unlike thematic analysis, protocol analysis can provide descriptions of clinical reasoning in depth and of how pharmacists move from one knowledge state to another. Protocol analysis has not been widely used in pharmacy to study clinical reasoning.[49,50] Therefore, we proposed

protocol analysis for this study to add to the body of knowledge of pharmacists' clinical reasoning while checking medication appropriateness in a community pharmacy setting.

4.3 Objectives

The overall objective of this study is to describe using protocol analysis pharmacists' clinical reasoning when checking for medication appropriateness. Specific objectives are: 1) to identify operators that pharmacists employ when they move from one concept to another, and 2) to describe pharmacists' overall clinical reasoning approach (e.g., hypothetico-deductive or pattern recognition) when they check for medication appropriateness.

4.4 Methods

4.4.1 Design

This is an exploratory-descriptive study. It aims to describe pharmacists' clinical reasoning when checking for medication appropriateness for a simulated patient in a community pharmacy setting. In this study, we used protocol analysis for two types of verbal reports, concurrent and retrospective think-aloud. Concurrent think-aloud (CTA) involves pharmacists checking for medication and thinking aloud simultaneously. Structured retrospective think aloud (RTA) involves pharmacists explaining their reasoning regarding medication appropriateness after completing the simulation.[18,161]

4.4.2 Sample

Participants in this study came from a larger study aimed at evaluating pharmacists' communication styles before and after receiving a training on a communication model, the vital behaviours model. In the larger study, managers from a chain pharmacy were asked to identify pharmacies in British Columbia to participate. In this study, we used verbal reports from the

baseline data set (i.e., pre-training) to avoid any biases that may have emerged during training. This data set was collected in September 2014.

4.4.3 Procedure

All data was collected by one researcher, MBN who has experience acting as a simulated patient. To ensure consistent data collection, he followed a protocol checklist designed by LMG, an expert in qualitative data collection. We scheduled data collection at the pharmacists' convenience to avoid the busy hours of the pharmacy. MBN informed the pharmacists about the procedure of data collection and simulation. The data was collected in a private room, where there was a minimum amount of noise and distraction. Video recordings were used to capture all patient-pharmacist interactions, the CTA session, and structured RTA session.

4.4.4 Simulation

A simulated patient in pharmacy research is a patient actor who is trained to enact a scenario that tests a specific behaviour of the pharmacist.[162] Think-aloud studies have often used simulations instead of real settings as the latter may lead to variability between participants and possibly contaminate the research process.[38,163] In this data set, we used a simulated case that was developed by MBN based on a real-life patient case and MBN's clinical knowledge and experience of common drug-related problems (Appendix 2). The simulated case was reviewed by two experts in pharmacy and clinical practice. The simulated case was not designed to challenge the pharmacists clinically, lead them to make a diagnose or a drastic intervention. The case aimed to assess how pharmacists check for medication appropriateness, so we ensured that it provided clear opportunities to explore medication indication, effectiveness, safety, and compliance (Appendix 2). In this simulation, MBN presented with a new prescription of Candesartan 16 mg. Pharmacists were asked to accept the prescription and gather all the

information they needed from the simulated patient (i.e., drop off consultation). They were asked to talk to him as if they were talking to a new patient at their pharmacy. Afterwards, the pharmacists were asked to verbalize their thoughts while processing and checking the prescription as if it were a real prescription in their daily practice. Once the pharmacists completed checking for medication appropriateness and had the simulated patient's medication ready, a second interaction occurred with the simulated patient (i.e., pick-up consultation). This interaction was designed to simulate prescription pick-up so that pharmacist could go through any counseling tips or directions and gather more information for the simulated patient to ensure appropriateness. After the simulated case, we conducted a structured retrospective session to ask pharmacists how they determined if the patient's drug-related needs were being met. In this study, we primarily relied on the CTA and retrospective data for protocol analysis. However, we checked the case simulation data (i.e., drop off and pick-up consultations) when clarification or verification of findings was required.

4.*4.5 Verbal Reports*

Two verbal reports were collected in this study, one for the CTA session and one for the structured RTA. The CTA data was collected by having pharmacists think aloud as they evaluated medication appropriateness, whereas in the structured RTA pharmacists were asked questions on how they evaluated medication appropriateness.

4.4.5.1 Concurrent Think-aloud (CTA) Session

All pharmacists in this data set were prepared to perform the CTA by giving them a simple task: to think aloud as they counted how many windows are in their house or apartment. Similarly, pharmacists were asked to verbalize every step in the dispensing process and state aloud what they were thinking about, looking at, and doing as if they were explaining this task to a junior

pharmacy student. Pharmacists started the CTA session immediately after the drop off consultation.

4.4.5.2 Structured retrospective think-aloud (RTA)

Following the clinical simulation, pharmacists were asked five questions in the structured RTA session: one to identify what was important to the patient and four adopted from the pharmacotherapy work-up to uncover pharmacists' clinical reasoning when checking for medication appropriateness. These four questions were: "How did you decide that the medication was safe for this patient?"; "How did you decide that the medication was indicated?"; "How did you decide that the medication was effective?"; and "How did you decide that the patient is going to adhere to therapy?".[46] We conducted protocol analysis for the four questions adopted from the pharmacotherapy work-up.

4.4.6 Transcription

All recordings were transcribed by an experienced transcriptionist and checked for accuracy and to ensure that all gestures and non-verbal behaviours and actions were noted. We returned to the original recording when there were vague or unclear references (e.g., "I check this against this").

4.4.7 Protocol Analysis

Protocol analysis is a method used to analyze verbal data to gain insight into cognitive thinking. It was originally described by Newell and Simon.[29] It was later refined in clinical reasoning studies.[164-168] In this study, we primarily followed the protocol analysis of Hoffman et al. as it was the most recent as well as the most carefully described protocol analysis in the clinical reasoning research area.[102]

There are three steps to the refined protocol analysis: referring phrase analysis, assertional analysis, and script analysis. Referring phrase analysis isolates the information that pharmacists concentrate on while checking prescriptions (i.e., concepts). Transcripts are coded according to these concepts. Assertional analysis identifies the relationship that participants form between and among the concepts identified in referring phrase analysis. Script analysis provides a description of the overall structure of the clinical reasoning process pharmacists use while assessing prescriptions. First, however, we need to start with referring phrase analysis and assertional analysis as they are preliminary steps to script analysis.

4.4.7.1 Data Preparation

MBN, LMG, and an expert in verbal protocols (MKC) started this step of analysis by selecting a subsample of three random transcripts from both the CTA and structured RTA data. We reviewed these transcripts for general meaning and then broke them down into segments. These segments consisted of a single word, phrase, or a full sentence that referred to a specific action that pharmacists described in their verbal reports. We segmented the subsample separately, compared results, and resolved dissimilarities. We also created a numbering system for these segments (Appendix 3). MBN segmented the remaining transcripts following the same rule applied to the subsample.

4.4.7.2 Referring Phrase Analysis

Once all transcripts were segmented and numbered, we chose a subsample to identify concepts. The initial coding for concepts was provisional to produce concepts to fit the data and define concepts to guide the coding process forward. All transcripts were coded following the same approach. New concepts emerged as the coding progressed, and some were redefined or recoded after repeated examination of the transcripts.

4.4.7.3 Assertional Analysis

In this stage, we identified how pharmacists moved from one concept to the next by identifying the operators that describe the move. When we started this stage of analysis, we reviewed the operators that had been described in the literature.[38,102,165,169-171] We then developed operators by attentively analyzing the data and comparing it to pre-existing literature. Similar to our process during the referring phrase analysis, we chose a subsample and started selecting operators that matched the segments that we identified. Afterwards, we identified operators for the rest of the transcripts. Following these steps, MBN produced preliminary results for this study.

Later, we checked the preliminary results as a group, reviewing almost 70% of the segments line by line to ensure accuracy. The few discrepancies and disagreements in our operators coding were discussed, which led us to redefine our operators' list and definitions accordingly. The final list of operators and definitions was revised multiple times to ensure accuracy and clarity (Appendix 4). All segments in the CTA and structured RTA data were revised according to the final list of operators and then reviewed again by filtering segments per operator to ensure consistency in coding. These additional steps of analysis refined the preliminary results and ensured quality control and rigour in this study.

Afterwards, MBN created a problem behaviour graph for each transcript. Each transcript (for both CTA and structured RTA data) was graphed separately and numbered to correspond with the pharmacist's ID number (Appendix 5 and 5). Each graph was numbered to correspond with the participant number. In the X axis, the recorded operators in order of their appearance in each transcript. In the Y axis, the identified concept of each segment was recorded in sequential order. A line was drawn from the concept of each segment to the operator identified for that phrase and numbered in sequential order according to their appearance in transcripts.

4.4.7.4 Script Analysis

In script analysis, we identified pharmacists' overall clinical reasoning approach. This was achieved by aggregating operators to identify the process of cognition. We identified clinical reasoning approaches primarily from what has been described in the literature (Table 4.1).

4.4 Results

In this section, we will illustrate the findings of the protocol analysis. We will begin with pharmacists' demographics, after which, we will present the findings from the CTA and structured RTA data separately.

4.4.1 Participants

A total of 17 pharmacists from eight different pharmacies participated in this study, which was comprised of eight males and nine females (Table 4.2). Pharmacists were practicing as full-time community pharmacists from Metro Vancouver with an average of 9.1 years of experience (Table 4.2). In clinical reasoning studies, clinicians are often classified as novices or experts to describe their level of experience. In this study, however, we used a more explicit classification adapted from Benner.[153] Novices in this classification are beginners with no experience.[153] We, therefore, did not identify any novices in this study since participants had at least one year of experience (Table 4.2). The levels of expertise identified in this study were: 1) advanced beginner (less than 3 years of experience), 2) competent (3-5 years of experience), 3) proficient (5-10 years of experience), and 4) expert (more than 10 years of experience).

4.4.2 Concurrent Think-aloud (CTA) Protocol

In the referring phrase analysis, we identified 45 different concepts (Table 4.3). Later, we grouped similar concepts into 10 categories (Table 4.3). We identified two type of concepts, technical and clinical. The technical concepts refer to segments where pharmacists reported

dispensing activities (e.g., verifying prescription, packaging, and labeling). Whereas clinical concepts refer to segments where pharmacists evaluated medication from a clinical perspective (e.g., pharmacotherapy work-up). Clinical and technical concepts were later grouped into categories (Table 4.3). The majority of segments we coded in the CTA data were of a technical nature (Table 4.3).

In the assertional analysis, we identified 11 different operators for all concepts (Table 4.4). The most commonly identified operator was "verify" which was primarily associated with technical concepts (Table 4.4 and Appendix 7). In the CTA problem behaviour graphs, we used dotted lines to illustrate how pharmacists moved from one technical concept to another and straight lines for clinical concepts (Appendix 5). The distinction between clinical and technical concepts in the graphs facilitated the tracking of the ways that pharmacists moved from one clinical concept to another toward making a decision regarding medication appropriateness and prevented the researcher from becoming distracted with the technical concepts. The distinction also provided a visual representation of the extent of clinical and technical checking using in the CTA protocol.

In the script analysis, we only included the clinical concepts and their corresponding operators (i.e., straight lines) as they align with clinical reasoning and our research objectives.

We identified one clinical reasoning approach in the CTA data. Fourteen pharmacists used a forward-chaining approach, by applying multiple operators to reach a decision or a conclusion. Pharmacists with this approach used operators in roughly the order illustrated in Box 1. All pharmacists who followed forward-chaining in CTA made a decision regarding medication safety. Of those who followed forward-chaining in CTA, one pharmacist discussed effectiveness, and another made reference to the main drug-related problem in the simulated case (i.e., cough).

Box 1: Example of a forward-chaining reasoning approach

RPh 101 "First thing I'll be looking for is any allergies that could potentially interact with this medication (1) so the patient let us know that they're allergic to penicillin (2) so nothing there (3) I just checked the prescription to the hard copy here (4) so the name would be correct (5)* doctor (6)* checking their needs here (7)* the medication if it's appropriate and (8) it's an appropriate change from what he was getting previously (9) so from Altace to the Candesartan (10) so that's okay (11) Then I'd go to PharmaNet (12) and make sure there's not any other medications (13) that he didn't tell me about (14) that could potentially interact with this one (15) anything that could cause extreme hypotension (16) because that seems to be an issue here and (17) that is it so I'll call the patient back (18)."*

The operators used were "explain" (1), "review" (2), "conclude" (3), "act" (4), "verify" (5), "verify" (6), "verify" (7), "explain" (8), "infer" (9), "review" (10), "conclude" (11), "act" (12), "collect" (13), "explain" (14), "infer" (15), "infer" (16), "explain" (17), "exit" (18)

* Segments 4-7 are technical segments, represented as dotted lines in the problem behavior graphs. These technical segments were not included in the script analysis and clinical reasoning approach.

Three pharmacists did not express any clinical reasoning approach (i.e., RPh 301, 602, and 801). They spent the entire the CTA session verifying technical concepts or reviewing medication directions and patient's past medical history (Box 2).

Box 2: Example of no clinical reasoning expressed in CTA

RPh 801 "Okay so [patient name] (1), birthdate is [ah] November 9, 1983 (2), address (3), he's a male (3), history (4), this is Dr. [physician name](5). Okay, license number, okay (6)… Candesartan (7) 16 mg (8), he needs three months (9), 90 tablets (10), 90 days (11), take one tablet once daily, okay (12)*, so no refills, no refills (13) [pause]. Okay, the cost is 42, it doesn't have extended coverage. (14) Okay [pause].*

Interview: "Ready?" RPh 801 "Ready."

The operators used were "verify" (1), "verify" (2), "verify" (3), "verify" (4) *, "verify" (5), "verify" (6), "verify" (7), "verify" (8), "verify" (9), "review" (10), "verify" (11), "verify" (12) *, "verify" (13), and "verify" (14).

* Segments 4 (past medical history) and 12 (directions) were the only identified clinical segments in this CTA.

4.4.3 Structured Retrospective Think-aloud (RTA)

The structured RTA sessions produced only clinical concepts that we later grouped into categories (Table 4.5). We identified new operators in the structured RTA data (i.e., "overlooked", and "match") that did not appear in the CTA data (Table 4.6). The operator "match" was used when pharmacists were matching the current patient or situation to similar patients or situations (i.e., pattern recognition. This operator appeared nine times in the RTA transcripts (Table 4.6).

Eight pharmacists reported that they "overlooked" at least one of the pharmacotherapy work-up elements. The operator "overlooked" refers to pharmacists acknowledging that they forgot to check for something or commenting on what they could have done differently (i.e., "I guess I should have…."). This operator emerged in the RTA sessions because pharmacists were prompted with questions and they did not necessarily examine it in the CTA sessions. For this reason, we separated the operator "overlooked" from other operators in the problem behaviour graphs (Appendix 6). The emergence of "overlooked" operator indicated a new type of reasoning (i.e., hindsight reasoning). This type of reasoning was designated to RTA data where pharmacists acknowledged "overlooked" concepts, or provided new thoughts that were not reported in the

simulation and CTA sessions. In order to verify hindsight thoughts, we checked consultation (drop off and pick) and CTA sessions. The analysis of these sessions is reported in chapter 3. The purpose of this study is to characterize pharmacists' clinical reasoning as they occurred in the simulation. Since hindsight reasoning does not refer to how pharmacists evaluated medication in the clinical simulation, it was distinguished from other reasoning approaches that actually occurred in the simulation (Table 4.7). Hindsight reasoning was identified for 22 decisions in the RTA sessions (Table 4.7), the majority of these decisions were made regarding medication effectiveness. Some of these hindsight decisions were characterized with one of the system 1 or 2 approaches (Box 3), and some other were with no clear clinical reasoning approach (Box 4). In two examples (RPh 102 and 501), we identified segments that suggest hindsight decisions in combination with other decisions that actually occurred (Appendix 6, Table 4.8). We also noted that a pattern on expressed hesitation and uncertainty in CTA and RTA sessions; these hesitations were expressed verbally and nonverbally, such as "but yes, we don't know for sure", (RPh 102); "That dose should be decent so that's good [hesitation in voice]", (RPh 402); "so that's how I would check the prescription. [pause][rolling her eyes thinking] I'm just trying to think of if I would think of this, if I missed anything in my day to day", (RPh 502); "I'm not sure if he's been on a different one before"; (RPh 802).

4.4.3.1 Indicated

The most common concepts identified in this question were "clinical effect" and "decision" (Appendix 8). We also identified 10 different operators, the most common being "infer" and "review" (Appendix 8). The majority of pharmacists followed forward-chaining approach to describe their reasoning for indication (Table 4.7). We also identified two pharmacists that used hypothetico-deductive approach. The forward-chaining and hypothetico-deductive approaches

are similar in terms of being systematic and analytic; however, hypothetico-deductive is backward approach. It starts with a decision or a conclusion and then proceeds with analyzing or justifying it. In the hypothetico-deductive reasoning approach pharmacists used operators largely in the order illustrated in Box 5.

Box 3: Example of hindsight reasoning expressed with forward-chaining

RPh 102 " [um] Well, now I am not sure if I did do that (1), [um] I think that the [um] was not allergic to anything (2), so we know the patient hopefully won't be allergic to this individual thing (3), because [um] he has an indication of no allergies (4), [um] It should be fine (5). [um] The doctor has determined the strength (6), so I guess that's according to what the blood pressure was taken in the office (7), and [um] now I can't remember what strength (8), or I guess it wasn't told what strength the Altace was, just that it was Altace (9), [um] so I'm assuming maybe it was, like, 10 mg Altace (10), that would be hopefully a comparable dose [um] (11) and [um]just to reiterate that it can cause dizziness (12) and that hopefully he won't [um] have a fall or pass out from standing up too quickly (13)."

The operators used were "overlooked" (1), "assume" (2), "predict" (3), "explain" (4), "conclude" (5), "review" (6), "review" (7), "review" (8), "overlooked" (9), "assume" (10), "predict" (11), "review" (12), and "predict" (13).

Box 4: Example of hindsight reasoning with no clinical reasoning approach expressed.

RPh 701 "I did not (1), I just told him to try to take it in the morning [laughter] (2), and hopefully I'll catch it on the follow-up and subsequent refills (3).

The operators used were "overlooked" (1), "act" (2), and "plan" (3)

Box 5: Example of a hypothetico-deductive reasoning approach

RPh 701 "It's not an ACE inhibitor and safe(1), it's a reasonable dose, it's not super high, it's not super low (2), He was already on 10 mg Ramipril(3). so it's not like he was on a weak antihypertensive (4), so he was already having significant blood pressure lowering effects from the Ramipril (5), so I didn't think starting at 16 was much of a risk (6)[um] The risk, in my mind, would have been if he had taken this too early, given the spacing from his last dose of Ramipril (7), which is why I asked him when he took his last dose (8) I want to make sure that he's not taking two antihypertensives too close together (9), or else his blood pressure might drop down a little too much in the first day. (10)"

The operators used were "conclude" (1), "infer" (2), "review" (3), "infer" (4), "review" (5), "infer" (6), "review" (7), "explain" (8), "verify" (9), and "explain" (10)

We also identified two pharmacists who used system 1 reasoning; one was automaticity (RPh 201) and one was intuition (RPh 702). Automaticity and intuition are similar in terms of making decisions with little or no conscious awareness. In automaticity, pharmacists reported internalized decisions or assumptions made in the clinical simulation in quick and automatic fashion with no justification. (Box 6). Whereas in intuition pharmacists provide a justification to their decisions (Box 7).

Box 6: Examples of automaticity

*RPh 201: "*because they were needing it for blood pressure" (1)
One operator was used, "infer" (1)

Hindsight reasoning with automaticity

*RPh 102: "*Oh, well, I didn't make him promise *(1),* [um] Yeah, I mean I'm assuming he was taking his [ah] Altace regularly *(2),* so [um] I'm assuming…I did say for him to take it the same time each day *(3)* but [um] I guess there's no guarantee (4)."
The operators used were "overlooked" (1), "assume" (2), "assume" (3), and "assume" (4)

Box 7: Example of intuition

*RPh 702: "*Cause I keep saying "It's for your blood pressure," and he'd be saying , (1) "no, it's not", so I guess that's a safe assumption he is taking it for blood pressure. (2)*"*

The operators used were "explain" (1), and "assume" (2)

4.4.3.2 Effectiveness

The majority of pharmacists did not check of effectiveness in consultation (drop off and pick-up) and CTA sessions (Chapter 3). Therefore, most effectiveness decisions were made in hindsight. The majority of these hindsight decisions were done using system 2 (Table 4.7); four were hypothetico-deductive, two were forward-chaining, and two were if/then. The latter is a conditional approach that drove the pharmacist's decisions along with their prediction of outcomes based on logical conditions (Box 8). This approach did not involve a particular number

or order of operators, but it was identified by examining the segments and identifying instances that looked like "if… then…".[102] We also identified two pharmacists who used pattern recognition in hindsight (Box 9). This reasoning approach was associated with the operator "match".

Box 8: Example of an if/then approach

RPh 101 "'Cause it lowers the blood pressure. (1) It's not a significantly high dose (2) and ***if*** *they're stopping the other the other hypotensive medication, (3)* ***then*** *it shouldn't be an issue. (4)*

Interviewer: "Alright."

*RPh 101 "****If*** *they were taking both at the same time, (5)* ***then*** *yes, it would not be safe.(6)"*

RPh 101 used if/then twice in this example (3-6). The operators used were "explain" (1), "infer" (2), "explain" (3), "conclude" (4), "explain" (5), and "conclude" (6).

Box 9: Example of pattern recognition approach

RPh 201"[um] Well it's commonly used [um] if somebody does get a cough from from one of the ACE inhibitors (1). So this is usually the next [um] alternative (2)"

This represents a pattern recognition approach. The operators used were "match" (1), and "infer" (2).

4.4.3.3 Safety

The most common concepts identified in this question were "decision", "dose", and "allergies" (Appendix 8). We also identified 10 different operators, the most frequent was "review" (Table 4.6). In this question, the majority of pharmacists used system 2 reasoning (Table 4.7). We also identified who used dual process theory (Table 4.7). In this dichotomous approach, pharmacists used system 1 (i.e., pattern recognition) to make decision followed by system 2 (i.e., forward-chaining) to support decision.

Box 10: Example of dual process theory

RPh 602 "The dose is, I guess a common average dose, (1) and if they've been on the Altace 10 (2),10 it's [pause]I guess, comparable (3), and they've already been on it before and it was controlling their blood pressure [pause] at 120/70. (4) I think [rolling her eyes thinking] (5)"

The operators used were "match" (1), "review" (2), "infer" (3), "infer" (4), and "conclude" (5). In segment 1, RPh 601 used pattern recognition to check dose in segment and supported her decision with forward-chaining (2-5).

4.4.3.4 Compliance

The most common concepts identified in this question were "decision" and "follow up" (Appendix 8). We also identified 11 different operators, the most frequent of which was "explain" (Appendix 8). The majority of pharmacists used system 2 in this question, with forward-chaining being the common approach (Table 4.7). We also identified five compliance decisions made in hindsight (Table 4.7).

4.4.3 Clinical Reasoning and Expertise

Almost all pharmacists conducted forward-chaining reasoning CTA sessions regardless of level of expertise (Table 4.8). Similarly, in the RTA sessions the majority of decisions made by advanced beginner, competent and proficient pharmacists were forward-chaining with little to no hindsight reasoning (Table 4.9). On the other hand, nearly half of expert pharmacists made decisions in hindsight, whereas the other half used system 2 reasoning (Table 4.9). We identified two experts (RPh 102 and 201) who made decisions in hindsight with no clinical reasoning (Table 4.8).

4.5 Discussion

The main objective of this study is to characterize pharmacists' clinical reasoning when they check for medication appropriateness. This study presents original data collection and an analysis approach in community pharmacy practice research. Previous studies in pharmacy followed different methodological approaches to answer similar research questions.[48-53] In this section, we will discuss separately the overall findings of each verbal report and the clinical reasoning approaches.

4.5.1 Concurrent Think-aloud

In this study, the majority of the concepts identified in the CTA data were technical in nature. This emphasis suggests that pharmacists spend more time checking for technical elements of the prescription rather than using their time efficiently to apply their clinical expertise and knowledge. This emphasis is also consistent with the findings of our pilot study, in which pharmacists allotted 80% of their time in CTA on technical and dispensing activities.[55] Studies suggest that pharmacists have conflicting beliefs between their view of their professional and dispensing roles,[73,172] and that most of their practice time is allotted to dispensing activities.[72,73,87-89,91]

The operator "verify" was by far the most common operator identified in the CTA data. The majority of the concepts that pharmacists verified were components of the computer printout or the hard copy of the prescription. The task of processing prescriptions includes matching the information on the prescription with the computer printout to check for accuracy. The operator "verify" was infrequently accompanied by clinical concepts. In one extreme example, RPh 602 only used "verify" to check for clinical concepts.

All pharmacists who followed system 2 in CTA made a decision regarding medication safety. It is possible that pharmacists were prompted to check for safety by the computer printout; in fact, the computer printout explains most of our findings in the CTA data. The computer printout has almost all the technical concepts pharmacists verified in the CTA data (e.g., patient demographics, prescriber information, quantities, and cost). The computer printout also has sections for allergies and interactions, which possibly prompted pharmacists to check for safety. At this particular chain pharmacy, the computer software alerts pharmacists to any possible drug interactions or allergies and requires pharmacists to check for that alert before they proceed with dispensing medication. It is possible that the computer software and printouts created a clinical reasoning routine in pharmacists' daily practice. In three extreme examples, pharmacists did not express any clinical reasoning approach and relied completely on the computer printout to decide that the medication was appropriate (RPh 301, 602 and 801). It is possible that these two instances in CTA sessions were entirely guided by the computer printout, and pharmacists only reported heed traces (i.e., what the subject is attending to or is aware of). Similarly, pharmacists in previous studies demonstrated a structured sequential approach using 'WWHAM' questions, asking them in formulaic or routine manner.[51,52] However, pharmacists did not verbalize linking information gathered to make a decision.[48] Therefore, the authors concluded that pharmacists did not follow a particular reasoning approach.[48] In our pilot study, thematic analysis suggested that pharmacists rely on routines and computer hardcopies to make assessments.[55]

4.5.2 Structured Retrospective Think-aloud

The structured RTA protocol was an important addition to this research paper. It produced new findings that we could not have inferred from the CTA data alone. The structured RTA sessions did not produce any technical concepts since pharmacists were prompted with clinical questions

and did not rely on the computer printout to answer these questions. The absence of technical concepts in the RTA sessions gave us the opportunity to conduct the script analysis without becoming disarrayed by nonclinical data. In comparison to the CTA, this verbal report also generated a clear reduction in some operators (i.e., verify and act), and an increase in other operators (e.g., infer, and review). We also found new operators in the structured RTA data (i.e., overlooked and match). These new operators generated new system 1 approaches (e.g., pattern recognition) and hindsight reasoning.

The emergence of the operator "overlooked" in the RTA data was a significant finding in this study. This operator ranked fifth among the RTA's identified operators; it appeared 25 times. This is a key finding in this study, because it suggests that these pharmacists did not internalize these thoughts and decisions in the CTA session and that some pharmacists reconstructed their responses in the structured RTA and provided answers from their long-term memory. Tendency to reconstruct is known to be a limitation of RTA protocol.[18,24,32] This operator also suggests that our findings in the CTA were not an artifact of the method and that the computer printouts created a technical routine that hindered pharmacists from being more clinically focused in the CTA session. This operator has also suggested a new type of reasoning in the structured RTA data (i.e., hindsight reasoning) in which pharmacists reported thoughts that did not occur in the clinical simulation, or acknowledged "overlooked" concepts. These thoughts were possibly triggered as pharmacists were prompted by the pharmacotherapy work-up questions. It is also possible that the structured questions put pharmacists under the social pressure to provide thorough answers. Furthermore, it is possible that pharmacists were not expecting to be asked open questions regarding the pharmacotherapy work-up elements and the role of surprise reconstructed their thoughts.[173] Hindsight thoughts suggest that participating pharmacists have

the clinical knowledge and expertise to perform the pharmacotherapy work-up; however, they did not express that knowledge in the CTA session. This became evident when pharmacists acknowledged that they "overlooked" concepts in CTA.

Some of the pharmacists who performed system 2 reasoning to check for allergies and concomitant medications in the CTA sessions as these elements were on the computer printout. However, they thought of other safety elements in hindsight when prompted in the RTA session (i.e., RPh 102). These pharmacists acknowledged that they "overlooked" or "assumed" concepts in structured RTA session. This finding is a piece of supporting evidence that pharmacists used system 2 to check for safety because they were prompted by the computer printout. This finding also suggests that pharmacists did not internalize or forget to verbalize their thoughts in regarding other pharmacotherapy work-up elements; they undoubtedly did not conduct a thorough check or did not checked them at all.

As for the pharmacists who showed no clinical reasoning in the CTA session (i.e., RPh 301, 602 and 801), they did not report that they "overlooked" anything in the structured RTA session. In fact, RPh 301 used system 2 for all questions in the structured RTA session. Whereas, RPh 602 and 801 used a mix of different approaches for indication safety and compliance. These pharmacists possibly constructed reasoning to answer these questions in the pick-up session that followed the CTA session and preceded the RTA session.

4.5.3 Clinical Reasoning Approaches

4.5.3.1 System 1

Overall, this system was used in the structured RTA data. We subcategorized this system into the following: intuition, automaticity, and pattern recognition.

4.5.3.1.1 Intuition and Automaticity

We identified occasional use of intuition reasoning approach made with little effort to explain decisions. We also identified pharmacists who made automatic decisions and conclusions in one step without explaining how they reached their decisions. We often see the operator "assume" with automaticity with no clear explanations indicating that decisions were made based on quick and instinctive assessments. This prevalence of assumptions and instinctive judgments is consistent with our finding in the pilot study and Chapter 3 that pharmacists frequently rely on assumptions and often check medication appropriateness using incomplete information.[55] This automaticity approach has been reported in the nursing literature, and some studies have made a distinction between automaticity and intuition.[102,151] However, we were not aware of any studies in pharmacy that made such a distinction.

In this study intuition reasoning was conducted by proficient and expert pharmacists, whereas all automaticity decisions were conducted by experts. The latter were primarily conducted in hindsight; these decisions were prompted by the structured questions we asked in the RTA. It is possible that pharmacists retrieved only a single-step memory or retrieved knowledge from their long-term memory to answer these questions. It is possible that pharmacists could have given us more detailed answers if we asked them to elaborate. However, providing pharmacists with more prompts to explain their reasoning will possibly increase the demand on retrieving information from the long-term memory and ultimately increase the reconstruction level.

4.5.3.1.2 Pattern Recognition

In structured RTA sessions, we identified the operator "match" pharmacists that suggests a pattern recognition approach. This approach appeared in the structured RTA data but not in the CTA data. This discrepancy suggests that pattern recognition may have occurred in the CTA

sessions, but subconsciously. Similar findings were reported by Hoffman, and it is not clear if this subconscious pattern matching is the same as intuition of not.[102] CTA may have incomplete reports because only heeded traces are verbalized and, as a result, parallel or automated processing will not be reliably reported.[18,24,26] However, the combination of CTA and RTA provides a valid account of complete verbal reports.[21,27]

Psychologists believe that pattern recognition occurs due to the buildup of familiar patterns in long-term memory, and when we run across similar problems we solve them by retrieving those familiar patterns.[19,29] Therefore, in order to solve clinical problems using pattern recognition, a clinician needs to have extensive experience to have built these patterns into long-term memory and rely on them. Pattern recognition has been a successful approach of clinical reasoning and solving clinical problems.[174,175] It was also associated with higher diagnostic success in comparison to the analytical approach.[175] Previous studies in pharmacy suggested that experienced pharmacists sometime make decision driven by previous experiences of having seen similar patients, with an expectation to see certain clinical problem.[49,53] Experienced pharmacists have been found to make decisions based on past history with the specific patient or prior experience with similar patients needing clinical decisions.[53] However, this approach is not commonly described in pharmacy literature, and pharmacists do not usually use it exclusively to make decisions.[53]

4.5.3.2 System 2

We identified three approaches under this system, forward chaining, hypothetico-deductive and if/then. Forward-chaining was by far the most common reasoning approach in both the CTA and structured RTA data. In the CTA data, the majority of pharmacists used forward-chaining to

check for medication safety. Whereas in the structured RTA data, pharmacists used different system 2 approaches check for indication, safety and compliance.

4.5.3.2.1 Hypothetico-deductive and Forward-chaining Approaches

The majority of system 2 usage was expressed in a forward-chaining approach; however, a handful of pharmacists occasionally expressed a hypothetico-deductive approach in the structured RTA data in different questions. In CTA sessions almost all pharmacists followed forward-chaining approach, therefore, we could not identify a link between clinical reasoning approaches and expertise. In the structured RTA, however, forward-chaining was primarily used by non-expert pharmacists. System 2 reasoning has been previously identified in the pharmacy literature; Phansalkar et al. suggested that expert clinical pharmacists follow a forward-reasoning approach and use the information on patients' charts to make and validate hypotheses about possible adverse drug events.[49] Another study reported that less experienced pharmacists use the hypothetico-deductive approach as they need a deductive thinking process with a checklist similar to the patient care process.[53]

Evidence in the nursing literature suggests that expert nurses use forward reasoning more often, whereas novices and students lean toward a backward clinical reasoning approach.[102,176,177] Novices and students have less domain-specific knowledge and only look for information to support the hypothesis or decision they initially make.[102,178] It is suggested that expert nurses anticipate problems and collect information they need to validate their hypotheses.[102] Similarly, Elstein and Schwarz reported that experienced physicians are likely to use pattern recognition and automaticity, and rely on the hypothetico-deductive approach when they deal with difficult cases.[179]

4.5.3.2.2 If/ then Approach

In the structured RTA data, we identified decisions made using the if/then approach. The if/then approach has not been widely discussed in the clinical reasoning literature.[102,152,153] This logical deductive approach that starts with a rule, and proceeds with a conclusion.[180] We therefore classified this approach as part of system 2. However, the if/then approach is not as analytical and systematic enough as the hypothetic-deductive approach. It involves few operators (e.g., explain and conclude) and a simple rule but lacks an extensive retrieval of information and analyses. These characteristics make this approach more consistent with system 2. In this study we found experienced pharmacists are likely to use the if/then approach. In contrast, Banner reported that expert nurses do not tend to rely on this logical approach.[153] On the other hand, Hoffman reported that both expert nurses and novices use the if/then approach, but it was more often followed by novices.[102]

4.5.3.3 Dual Process Theory

In this study, we identified three decisions in the structured RTA sessions made using the dual process theory. In this approach pharmacists did not rely on system 1 or 2 exclusively, they relied on both side by side to make a particular decision. If we combine the results of all four questions in the structured RTA and look at them as one chain of decision made toward medication appropriateness, we find that seven pharmacists followed the dual process. This proclivity for the dual process theory is another key finding for this study since the dual process theory has yet to be described in the pharmacy literature.

In the past decade, the dual process theory started to become popular in the medical clinical reasoning literature. This model provided a solution to the dilemma of the two systems and explained puzzling findings in the clinical reasoning literature.[103,149,181] Studies suggest that

clinicians can switch from one system to another in their daily practice depending on circumstances, and complexity of cases.[104,149]

4.6 Strengths and Limitations

This study is descriptive study and does not aim to generalize findings beyond the study participants. Therefore, our sample size is not necessarily a limitation; in fact, it is comparable to studies of a similar nature.[102] The main strength of this study comes its inclusion of two types of verbal data, CTA, and structured RTA, which allows for a greater depth and completeness of information collected and enhances the study's validity. Including CTA data strengthened our data collection overall by reducing bias in recall, while including RTA allowed us to fill in the gaps in the CTA data. Other sources of both strengths and limitations include: the selection of verbal reports as data, the researcher (MBN), and simulation

4.6.1 The Selection of Verbal Reports as Data

The primary threat to validity in this study comes from the selection of verbal protocols as a method to describe clinical reasoning and cognitive thinking. MBN took the following measures to ensure validity in data collection: 1) training pharmacists to think aloud and prompting them to keep talking, 2) collecting two types of verbal reports as both methods can supply different,[182] and 3) collecting RTA data immediately after the simulated case, with a maximum of seven to ten minutes after the CTA session to avoid reconstruction of answers.[18,24,32]

Participating pharmacists are familiar with the pharmacotherapy work-up questions since they are related to the standards of practice in British Columbia.[127] It is possible that they anticipated the questions in the RTA sessions with provided proper answers accordingly. Therefore, MBN asked the pharmacotherapy work-up questions in a different order (patient concern, followed by safety, indication, effectiveness, and compliance) to minimize the pharmacists' anticipation. This

question order possibly confused a few pharmacists (i.e., RPh 101, 202 and 301) when they were asked about safety before indication. It was not clear if the question order created that confusion or if those pharmacists considered indication as part of safety.

Furthermore, verbal reports are susceptible to the Hawthorne effect; pharmacists may have modified or improved their behaviours when they knew they were observed.[18,27,30] This limitation, in addition to tendency to reconstruct [24,27,30] and the structured questions in RTA possibly produced hindsight reasoning in this study.

4.6.2 The Researcher

In this study, MBN carried out multiple roles in the data collection and data analysis phases. This can be a strength of this study as it increases validity and consistency in the collected data.[163] However, it may also have introduced bias to the study as MBN spent some time with the participating pharmacists. This marginal familiarity with the participants may have introduced a bias in the analysis according to his personal opinions or preferences developed while collecting the data. Therefore, we followed rigorous steps to minimize these concerns and increase objectivity in the data analysis. These steps are described in detail in section 4.4.7.

4.6.3 Clinical Simulation

Simulated patients have often been used under realistic conditions to control extraneous variables, thus maximizing external validity and ensuring generalizability.[165,171,183] However, clinical simulations have the disadvantage of providing incomplete representations of real patients and settings and not capturing all the variables found in the clinical environment. In order to achieve maximal representation of a real setting, MBN conducted the interviews in the pharmacies where the participants practice, and he also provided them with a simulated prescription hard copy, a pharmacy computer printout, and a medication vial. One caveat to the

simulated case in this study is that we did not assess the case content validity index[36,184] as we were not aware of this index prior to the data collection.

4.7 Implications

4.7.1 Implications for future research

Our study has several implications for future research in pharmacy. The study of clinical reasoning directed by the information process theory provided useful guidance in this research. Therefore, we recommend consideration of similar theoretical frameworks in subsequent studies. The use of verbal reports CTA and structured RTA was effective in answering our research questions, and we recommend their use these reports in future research. The collections of CTA data in conjunction with structured RTA data resulted in a complete and rich description of pharmacists' clinical reasoning. In fact, the two think-aloud reports were essential in recognizing whether decisions were internalized or overlooked. Furthermore, protocol analysis was a systematic and thorough method to analyze the verbal reports. In consonance with Fonteyn, "this type of analysis is not for the weak hearted."[166] However, it is an essential method to study clinical reasoning.

In this study and in the majority of other pharmacy studies, simulations were employed to examine clinical reasoning. In future, we recommend using real-life patients to advance and expand on this research area in pharmacy. This study did not aim to identify an association between clinical reasoning and expertise; therefore, we recommend the replication of our methods to compare between the clinical reasoning of both expert pharmacists and novices.

4.7.2 Implication for practice

This study demonstrates that pharmacists follow routines guided by the computer printout to check prescriptions. It is indeed important to have proficient dispensing routines, but it is imperative to check for medication appropriateness. Since this research paper and our pilot study concluded that pharmacists rely profoundly on computer printouts, we suggest adding a check on these printouts for the pharmacotherapy work-up elements (i.e., indication, effectiveness, safety, manageability). We also recommend to include the pharmacotherapy work-up elements as part of the documentation process. These added dimensions may create a new routine in pharmacists' checking process that includes more clinical areas to explore and will possibly minimize the overlooking any of the pharmacotherapy work-up.

4.8 Conclusion

In the CTA sessions, pharmacist' clinical reasoning appears to be more focused on technical and dispensing routines. Pharmacists predominately verified computer printouts and used analytical (system 2) reasoning when applied clinical skills; however, they did not check beyond safety. The findings of the structured RTA data suggest that pharmacists have the competency and knowledge to check for medication appropriateness. However, this knowledge was mostly restructured and recognized as hindsight reasoning. We also identified clinical reasoning approaches that were not identified in pharmacy studies before (i.e., automaticity, if/then and dual process theory). This study highlighted the significance of protocol analysis to study clinical reasoning in pharmacy, as well as retrospective protocols to expand the description of clinical reasoning.

Table 4.1: Definitions for clinical reasoning approaches

Clinical Reasoning Approach	Definition
1) System 1	
a) Automaticity	This system is characterized by being quick, automatic, and internalized. In RTA, pharmacists who followed this approach made decisions or assumptions without verbalizing a clear justification or reasoning behind these decisions or assumptions.
b) Intuition	This approach is a non-analytical and decision are made in a few steps with little to no awareness. In this approach, pharmacists relied mainly on few operators such as "verify", "review".
c) Pattern Recognition	In this approach, pharmacists matched current patient to past patients or predicted outcomes based previous similar experiences. The most significant operator to identify this approach was "match"
2) System 2	
a) Forward -chaining	In this approach, pharmacists followed an analytical approach using multiple operators to reach a decision or a conclusion. In this approach, pharmacists had operators close to the following order: 1) "verify" or "review; then 2) "explain"; then 3) "act" or "collect"; then 4) "infer"; then 5) "conclude".
b) Hypothetico-deductive	In this approach, pharmacists followed a backward analytical approach using multiple operators starting with a decision or a conclusion and then proceeded with analyzing or justifying it. In this approach, pharmacists had operators engaging largely in the following order: 1) "conclude" or "infer"; then 2) "review" or "act"; then 3) "explain"; then 4) "predict"
c) If/then	In the if/then approach, pharmacist's decisions or prediction of outcomes relied on a particular condition. This approach does not involve a particular number or order of operators, but it was identified by examining the segments and identifying instances that looked like "if… then…".
3) Dual Process Theory	In this approach, pharmacists do not use systems 1 and 2 mutually exclusive. Both systems are employed jointly to make a decision.
4) Hindsight Reasoning	In this approach, pharmacists reported thoughts in RTA that did not occur in the CTA sessions. These thoughts are characterized by pharmacists acknowledging "overlooked" concepts, or providing new thoughts that were not reported in the simulation and CTA sessions.

Table 4.2: Participant pharmacists' demographics

RPh ID	Gender	Age [a]	Years of experience [a]	Expertise	Store busyness
101	M	28	3	Competent	Busy
102	F	55	33	Expert	Busy
201	F	38	16	Expert	Busy with slow times
202	F	26	8	Proficient	Busy with slow times
301	F	32	3	Competent	Busy with slow times
302	M	29	10	Expert	Busy
401	M	36	9	Proficient	Steady
402	M	27	4	Competent	Slow with busy times
501	M	32	2	Advanced Beginner	Slow with busy times
502	F	28	1	Advanced Beginner	Slow with busy times
601	F	37	13	Expert	Steady
602	F	32	9	Proficient	Busy with slow times
603	M	26	2	Advanced Beginner	Steady
701	M	40	17	Expert	Busy with slow times
702	F	33	9	Proficient	Busy with slow times
801	M	37	4	Competent	Busy
802	F	32	9	Proficient	Busy with slow times
	Mean ± Std dev	33.4 ± 7.1	9.1 ± 7.5		

Abbreviations used: RPh, pharmacist; M, male; F, female; Std dev, standard deviation.

[a] Calculated at the data collection year (2014).

Table 4.3: Think-aloud concepts and categories

Category	Concept		Number of Segments
Drug Technical Information (n=91, 20.2%)	Drug Identification Number	Segments referring to a unique number on the label medications.	11
	Expiry Date	Segments referring to the expiry date of the dispensed medication	5
	Label	Vial labels that include patient, medication, and auxiliary labels.	12
	Identification	Segments that refer to product identification (e.g. color or shape)	25
	Vial	Segments referring to the container used to carry the dispensed medication	7
	Quantity	Segments that refer to the dispensed quantities	31
Patient Demographics and Background (n=53, 11.7%)	Patient Address	Segments that refer to patient's home address	8
	Patient Info	Segments that refer to nonspecific patient information	2
	Patient Contact Info	Segments that refer to patient's contact info (e.g. phone number)	3
	Date of Birth	Segments that refer to patient's date of birth	16
	Patient Gender	Segments that refer to patient's gender	2
	Patient Name	Segments that refer to patient's name	18
	Personal Health Number	Segments that refer to a unique patient identifier for health care in British Colombia	4
Prescription Information (n=100, 22.1%)	Prescriber Info	All segments related to the prescriber name, address, contact info, signature and clinic.	40
	Prescription	Segments that refer to the prescription hardcopy that the patient dropped off	20
	Prescription Date	Segments that refer to the date the prescription was written	8
	Strength	Medication strength (i.e., 16 mg)	12
	Refills	Segments that refer to subsequent refills in terms of when or the quantity remaining	11
	Identity	Segments related to the product brand or generic name	9
Hardcopy (n=35, 7.7%)	Printout	Segments that refer to computer printout that pharmacists used to check off the prescription. It has patient background information (e.g., name, age, gender), medical history, and medication related information (e.g., DIN)	26
	Printout Notes	Segments that refer to the patient special notes or needs section on the printout.	5
	Technical check	Segments in which made reference to nonspecific technical check	4
Retail Related Concepts (n=23, 5.1%)	Services	Services provided by pharmacy (loyalty cards)	3
	Bag	Segments related to packaging the product and placing it in a bad	7
	Cost	Segments related to billing, price and insurance	13
Patient Medical and	Previous Treatment	Segments related to other medication that used to treat the current medical condition (hypertension)	3

Medication History (n= 25, 5.5%)	Previous Usage	Segments that refer to previous usage of the medication in reference (Candesartan)	5
	Medication History	Segments related to the medications the patient has been taking in the past.	1
	Past Medical History	Segments related to patient medical conditions, and lab results.	5
	Concomitant Medication	Other meds that patient are currently taking.	9
	Patient Age		2
Medication Related Concepts (n=36, 8%)	Medication	Segment that has nonspecific reference to the medication	14
	Directions	Segments that refer to instructions on how to take the medication.	15
	Dose	Segments that refer to pharmacists discussing the medication dose	5
	Clinical Effect	Clinical effect of the medication in reference.	2
Adverse Drug Reaction (n=25, 5.5%)	Side Effect	Segments that refer to pharmacists reviewing or discussing potential side effects.	1
	Allergies	Segments that refer to pharmacists discussing patient's allergies	14
	Cough	Segments that refer to cough as a specific side effect of Ramipril and the main patient concern.	1
	Drug-Drug Interaction	Segments that refer to pharmacists discussing potential drug-drug interactions	9
Decision and Follow-up (n=51, 11.3%)	Decision	Segments that refer a conclusion or judgement.	47
	Follow Up	Segments in which pharmacists make reference to future discussions with the patient about treatment and medical condition.	4
Electronic Records (n=13, 2.9%)	Electronic Health Record	Segments that refer to a digital version of a patient's paper chart.	8
	Patient Profile		5

Table 4.4: Frequency of operators identified in think-aloud

Operator	Frequency
Verify	194 (42.9%)
Act	101 (22.4%)
Explain	70 (15.5%)
Review	30 (6.6%)
Conclude	22 (4.9%)
Collect	13 (2.9%)
Exit	10 (2.2%)
Infer	8 (1.8%)
Predict	2 (0.4%)
Assume	1 (0.2%)
Plan	1 (0.2%)

Table 4.5: Structured retrospective protocols concepts and categories

Category	Concept	Number of Segments
Patient Medical and Medication History (n=119, 33.1%)	Patient Age	1
	Allergies	11
	Blood Pressure	4
	Blood Pressure Reading	8
	Medication History	13
	Physician Assessment	7
	Past Medical History	6
	Previous Adherence	1
	Previous Treatment	29
	Previous Usage	2
	Hypertension	5
	Daily Routine	7
	Alternative Therapy	11
	Outcome	6
	Concomitant Medication	8
Medication Information (n=93, 25.9%)	Clinical Effect	24
	Medication	3
	Directions	9
	Dose	28
	Comparative	13
	Equivalent Dose	2
	Mechanism of Action	3
	Quantity	1
	Refill	10
Adverse Drug Reaction (n=31, 8.6%)	Drug - Drug Interaction	8
	Cough	14
	Side Effect	9
Electronic Records (n=4, 1.1%)	Drug Information Resources	3
	Electronic Health Record	1
Patient Related (n=16, 4.5%)	Patient Competency	2
	Patient Interest	3
	Faith in Patient	6
	Evident	5
Decision and Follow-up (n=96, 26.7%)	Decision	70
	Follow up	22
	Assertion	4

Table 4.6: Frequency of operators identified in structured retrospective protocols

Operator	Indicated	Effective	Safety	Compliance	Total %
Explain	8	27	15	22	72 20.1%
Review	14	10	33	11	68 18.9%
Infer	15	16	19	14	65 18.1%
Conclude	7	14	19	8	46 12.8%
Overlooked	2	11	5	6	25 7%
Predict	-	9	3	6	18 5.0%
Act	1	2	-	15	18 5%
Plan	-	4	-	8	12 3.3%
Collect	7	1	3	3	14 3.9%
Assume	3	-	2	5	10 2.8%
Match	1	3	4	1	9 2.5%
Verify	-	-	2	-	2 0.6%

Table 4.7: Clinical reasoning approach for each question in structured retrospective protocols

System	Approach	Indicated	Effective	Safety	Compliance	Total
System 1 (Intuitive, Heuristics)	Intuition	1	-	1	-	2
	Automaticity	1	-		-	1
	Pattern Recognition	-	-	2	-	2
	Total	***2***		***3***	***-***	***5***
System 2 (Analytical)	Hypothetico-Deductive	2	2	4	2	10
	Forward-chaining	9	3	7	8	27
	If/Then			1	2	3
	Total	***11***	***5***	***12***	***12***	***40***
Dual Process Theory (System 1 and 2)		1	-	2	-	3
Hindsight Reasoning	Automaticity	2	-	-	1	3
	Forward-chaining	1	2	-	-	3
	Hypothetico-Deductive	2	4	-	1	7
	If/then	-	2	-	-	2
	Pattern Recognition	-	2	-	1	3
	No clinical reasoning	-	2	-	3	5
	Total	5	12	-	6	23

Table 4.8: Participating pharmacists and corresponding clinical reasoning in CTA and RTA.

RPh ID	Clinical Reasoning Approach	CTA	RTA			
			Indicated	Effectiveness	Safety	Compliance
101	Forward-chaining	X	X			X
	If/then				X	
	Hindsight with hypothetico-deductive			X		
102	Forward-chaining	X				
	Hindsight with hypothetico-deductive		X			
	Hindsight with no clinical reasoning			X		
	Hindsight with forward chaining				X	
	Hindsight with automaticity		X			X
201	Intuition				X	
	Forward-chaining	X				
	Hindsight with pattern recognition			X		
	Automaticity		X			
	Hindsight with no clinical reasoning					X
202	Forward-chaining	X	X	X	X	
	If/then					X
301	Forward-chaining			X	X	X
	No clinical reasoning	X				
	Hypothetico-deductive		X			
302	Forward-chaining	X			X	
	Hindsight with if/then			X		
	Hypothetico-deductive					X
	Hindsight with automaticity		X			
	Hindsight with hypothetico-deductive		X			
401	Hindsight with hypothetico-deductive			X		
	Forward-chaining	X	X			X
	If/then					X
	Pattern recognition				X	
402	Hypothetico-deductive			X		
	Forward-chaining	X	X		X	X
	pattern recognition				X	
501	Hypothetico-deductive		X		X	

RPh ID	Clinical Reasoning Approach	CTA	RTA			
			Indicated	Effectiveness	Safety	Compliance
	Forward-chaining	X				
	Hindsight with pattern recognition			X		
	Hindsight with no clinical reasoning					X
	Hindsight with forward chaining			X		
502	Forward-chaining	X	X	X	X	X
601	Forward-chaining	X				X
	Dual process		X			
	Hypothetico-deductive				X	
	Hindsight with if/then			X		
602	Forward-chaining		X			X
	No clinical reasoning	X				
	Dual process				X	
	Hindsight with forward chaining			X		
603	Forward-chaining	X	X			X
	Dual process				X	
	Hindsight with no clinical reasoning			X		
701	Forward-chaining	X	X			
	Hindsight with no clinical reasoning					X
	Hypothetico-deductive			X	X	
702	Forward-chaining	X			X	
	Intuition		X			
	Hindsight with hypothetico-deductive			X		
	Hindsight with pattern recognition					X
801	Forward-chaining		X		X	
	No clinical reasoning	X				
	Hindsight Hypothetico-deductive					X
	Hindsight with forward chaining			X		
802	Hypothetico-deductive				X	X
	Hindsight Forward-chaining	X	X			
	Hindsight with hypothetico-deductive			X		

Table 4.9: Summary of clinical reasoning approaches used with different level of expertise in RTA

Clinical Reasoning Approach	Advanced Beginner	Competent	Proficient	Expert
Automaticity				1
Dual process	1		1	1
Forward-chaining	6	10	10	3
Hypothetico-deductive	2	2	2	4
If/then		1	2	
Intuition			1	1
Pattern recognition		1	1	
Hindsight	4	3	6	12
Hindsight with forward-chaining	*1*	*1*	*2*	*1*
Hindsight with automaticity				*3*
Hindsight with hypothetico-deductive		*2*	*3*	*2*
Hindsight with if/then				*2*
Hindsight with no clinical reasoning	*2*			*3*
Hindsight with pattern recognition	*1*		*1*	*1*

Chapter Five

Discussion and Future Directions

5.1 Summary of Research

This thesis includes three manuscripts that collectively aim to describe how pharmacists evaluate medication appropriateness and their clinical reasoning. The first manuscript (Chapter 2) is a pilot study in which we characterized how community pharmacists in Alberta gather patient information and how pharmacists evaluate medication using the Chat, Check, Chart model (i.e., a communication model).[55] We used a mixed method design to analyze audio-recordings of concurrent think-aloud and real-life pharmacist-patient interactions (i.e., consultations). Overall, pharmacists allotted less than 30% of the recorded sessions on clinical related issues for new and chronic medications. Pharmacists had a bias against refilling chronic medication; they covered less content areas when checking the appropriateness of a refill medication in comparison to new medications. All pharmacists checked if the medication was safe, but less than half checked if the prescription was indicated, effective, or manageable. The pilot study also identified routine activities that shaped pharmacists' practice including a bias against refill prescriptions and a focus on technical dispensing activities.

This pilot study inspired us to study pharmacists' clinical reasoning in-depth for the subsequent two manuscripts. For these two manuscripts, we collected data through four interconnected phases related to a single clinical simulation; consultations at prescription drop off, concurrent think-aloud, consultations at medication pick up, and structured retrospective think-aloud.

In the second manuscript (Chapter 3), we employed three phases of the aforementioned recordings (i.e., drop off, CTA, and pick-up) to characterized how pharmacists evaluated therapy

using the patient care process. We conducted quantitative analysis to describe pharmacists' use of the patient care process elements. The results of this quantitative analysis were different from the ones we reported in the pilot study, particularly for the pharmacotherapy work-up elements. In the pilot study, we coded the pharmacotherapy work-up elements only in CTA; in Chapter 3, however, we improved on the pilot study by coding elements of pharmacotherapy work-up in drop off and pick-up sessions. We also conducted a qualitative analysis using a generic qualitative approach to describe pharmacists' information-gathering and medication evaluation. Overall, the majority of pharmacists completed most of the patient-care process steps. Most of these steps were completed in the pick-up consultations, whereas the drop-off consultations and the CTA sessions were mainly devoted to dispensing activities. This analysis suggested that pharmacists expressed intuition and pattern recognition when they evaluated therapy and counseled the patient. The computer printout often played an important role in creating a routine in therapy assessment. The themes identified in Chapter 2 and 3 give insight to contextual factors that contribute to pharmacists' overall clinical reasoning process (e.g, practice and environmental factors) similar to those described by the situated cognition theory.

In the third manuscript (Chapter 4), we described pharmacists clinical reasoning approaches for the same clinical simulation used in the second manuscript. For this study, we used protocol analysis for two types of verbal reports, CTA and structured RTA. The RTA sessions are not a standard part of practice, we conducted these sessions after the clinical simulation. Therefore, pharmacists may have added additional thoughts that would not have occurred outside of the structured session.

Overall, the CTA sessions were devoted to verifying dispensing related information with heavy reliance on computer printouts, whereas the structured RTA sessions were devoted to clinical

assessments. In the CTA, the majority of pharmacists used analytical reasoning with forward-chaining approach to check for medication safety, and some did not show any clinical reasoning. More approaches were identified in the structured RTA sessions, the most common being forward-chaining with occasional use of intuitive approaches (pattern recognition and automaticity). In the structured RTA sessions pharmacists reported thoughts that did not particularly occur in the clinical simulation. These were characterized by the "overlooked" operator or new decisions that were not captured in CTA; this was described as hindsight reasoning.

5.2 Discussion and Significance of Research

Pharmacists are responsible for checking medication appropriateness every day. Pharmacists use these skills to identify and resolve drug related problem which have been shown to improve patient outcomes. However, undetectable drug related problems remain highly prevalent in the Canadian healthcare system. A recent review of reasons for emergency department visits in Canada identified that over 70% of admissions due to drug-related problems were determined to have been preventable.[4] A second analysis estimated that hospitalization costs of drug-related problems in Canada are up to $5.6 billion annually.[112,185] The prevalence of drug-related problem suggests a clear need to understand how pharmacists evaluate medication appropriateness and detect drug-related problems.

In this thesis, pharmacists showed clear attention in regards to medication safety and they often checked for manageability. The majority of safety evaluations were devoted to checking medication allergies and drug-drug interaction, and did not include checking the safety of other elements including the dose or other medical conditions. However, this level of checking is insufficient to make a complete assessment of therapy appropriateness. There are other elements

that contribute to drug-related problems (i.e., indication and effectiveness). Drug indication-related problems (i.e., untreated indication, and improper drug selection)[2,46,186] and effectiveness-related problems (i.e., sub-therapeutic dosage)[2,46,186] account for up to 35% of drug-related problem[187] and up to 25% of drug-related emergency department visits.[4]

Incomplete assessments of medication therapy can explain the prevalence of these drug-related problems. In this thesis, we described how pharmacists evaluate medication appropriateness when preparing prescriptions behind the counter (CTA sessions; Chapter 2 and 3). In these CTA sessions, we found that pharmacists sporadically checked for indication and effectiveness (Chapter 2 and 3). When we analyzed consultation sessions, we found that almost all pharmacists checked for indication at medication pick-up with sporadic attention to effectiveness (Chapter 3). These findings are consistent with our findings in Chapter 4; pharmacists devoted their analytical reasoning in CTA sessions primarily to check for safety and expressed hindsight reasoning for effectiveness in the structured RTA sessions. This hindsight reasoning suggests that pharmacists have the clinical knowledge to evaluate therapy appropriateness; however, they do not routinely conduct it. It is not unusual to see a discrepancy between observations and pharmacists' self-reports or interviews;[53,188] This could be due to tendency to forget, tendency to reconstruct or social desirability bias.[188]

This thesis suggests three reasons for incomplete evaluations of medication appropriateness and hindsight reasoning. First, pharmacists' heavy reliance on computer printouts and patient profiles as a source of patient clinical information (Chapter 2) and used in evaluating appropriateness (Chapter 2 and 3). The computer printouts used this study had elements to verify prescription accuracy and patient demographics, as well as allergies and concomitant medications. Consistent with these elements on printouts, we found that over 66% of the reported concepts in CTA were

technical concepts, and pharmacists' clinical decisions in CTAs they were primarily for safety elements (i.e., drug-drug interactions and allergies). This reliance appeared to create a routine in pharmacists daily practice and limit evaluation of therapy to checking prescription accuracy and aforementioned safety elements.

Second, pharmacists appear to have inconsistent assessments of therapy. In drop off sessions, they often missed opportunities to gather all clinical information needed to make a complete assessment of therapy. Therefore, CTA sessions were conducted based on instinctive judgments and assumptions. Pharmacists seemed to rely heavily on pick-up consultations to make a complete assessment; however, pick-up sessions do not necessarily occur in real practice. Therefore, it is important that pharmacists make complete assessments and elicit all clinical information before they proceed to processing prescriptions. Third, pharmacists are distracted from conducting a complete clinical check by dispensing and retail-related activities (Chapter 2 and 3). This was apparent when pharmacists simulated loyalty program cards and ringing through the till.

5.3 Recommendations and Future Directions

This thesis demonstrates that pharmacists make incomplete evaluation of medication therapy and consequently miss opportunities to detect and resolve drug-related problems. We, therefore, have recommendations for pharmacy practice, education and research to surpass these miss opportunities.

Pharmacy Practice

Optimizing pharmacy workflow is one important recommendation for this thesis. We recommend pharmacists devote more time to clinical tasks and counselling patients, and

minimize the time devoted to dispensing and retail- related activities. This can be achieved by regulated pharmacy technicians to dispense and check for prescription accuracy. However, not all pharmacies can find regulated pharmacy technicians; there is a shortage of regulated techs in community as most move to hospital for better pay.

Other workflow factors related to whether the pharmacist counsel patient at prescription drop off or medication pick-up seemed to play an important for missed opportunities. We, therefore, recommend pharmacists need to make complete and consistent assessments when they have the opportunity, and not assume that they will have multiple opportunities. Moreover, we noticed that printouts guided pharmacists' routine check for prescription appropriateness. We, therefore, recommend to create a new routine for clinical check. This can be achieved by including the pharmacotherapy work-up elements (i.e., indication, effectiveness, safe, manageability) on computer systems and on where pharmacists make legal signatures and documentations for prescription appropriateness.

Based on the findings on this dissertation, we could suggest changes in the pharmacy work flow to allow pharmacists time to devote additional time to clinical duties. We would recommend two steps for prescription drop off. First, a pharmacy technician could accept a prescription from a patient and gather demographic information. Second, the pharmacist would meet with the patient to identify patient needs, gather the clinical information (e.g., three prime questions), evaluate medication appropriateness, and provide patient education as required. Pharmacists would have physical prompts in their software to remind them to check elements of the pharmacotherapy workup before they sign to indicate the medication is appropriate. Following this pharmacist-patient interaction, pharmacy technician could check the prescription for completeness and authenticity, prepare the medication, check for accuracy, release the medication to the patient,

and conduct retail-related activities (e.g., loyalty program cards, processing payment).

Pharmacy Education

The patient care process is widely adopted as a clinical reasoning framework in pharmacy schools, particularly in North America. However, pharmacists do not routinely apply this framework in daily practice; therefore, we suggest some improvements in pharmacy education to train pharmacy students to master these skills. All three studies in this dissertation suggest that pharmacists' daily practice is guided by routines, the majority of these routines are not devoted to clinical check. We, therefore, recommend to implement a routine pharmacotherapy work-up check in education. We can create this routine by implementing pharmacotherapy-workup checklists in practice labs and clinical exams to constantly remind pharmacy students to evaluate them. This checklist can be closed-ended questions (e.g., did you evaluate indication?) and students sign next to each question for completion. Another checklist can be added to the assessment part of clinical documentations (e.g., DAP and SOAP notes). This checklist can be open-ended questions similar to the ones we used in the structured RTA sessions (e.g., how did you decide the medication is indicated for this patient). Implementing these checklists in school will ensure that students will routinely conduct pharmacotherapy work-up, and preceptors' evaluations and feedback will be more focused on the quality of how students make assessments rather than the occurrence.

Furthermore, clinical reasoning and decision making skills can be taught at the university level. Therefore, educators need to develop case studies that actually model how pharmacists can evaluate medication therapy appropriateness. Educators also need to expose students and model different clinical reasoning approaches; teaching one generic approach is not recommended.[102,189]

Pharmacy Research

Future research can benefit from the level of depth we described for research methods (i.e., interconnecting phases of data collection and protocol analysis) to advance and expand on this research area in pharmacy. These methods can be replicated using real-life patients and compare the clinical reasoning of both expert pharmacists and novices. Understanding how expert pharmacists make decisions is beneficial to equip pharmacy students and novices with skills to quickly become expert practitioners.

I also recommend future research in Canada to measure the effectiveness of my previous recommendations to optimize pharmacy workflow using randomized controlled trail. Canadian community pharmacies will make the ideal setting to implement my aforementioned recommendations as Canadian pharmacists are trained to provide patient care process and pharmacy technicians have a wide scope of practice that include a final check of prescription accuracy.

5.4 My Personal Future Plans

After finishing my Ph.D., I will be joining Yarmouk University as an assistant professor in my home country (The Hashemite Kingdom of Jordan). Therefore, my future research will be primarily conducted in a different practice setting and population from what I characterized in this dissertation. Before I start discussing my future research and teaching plans, I would like to start with describing the current status of pharmacy education and profession in Jordan.

The Hashemite Kingdom of Jordan is a small Arab country in the Middle East; it is approximately 15% the size of Alberta and a total population of 9.5 million. Jordan is a well-educated nation, with a literacy level of 95.9%.[190] Pharmacy is one of the most common degrees

sought by students in Jordan; hundreds of pharmacists that graduate annually from 12 different faculties of pharmacy inside Jordan. As of December 2016, there are over 2860 community pharmacies, and over 19,000 pharmacists registered in the Jordan Pharmaceutical Association. Of those, there are 1130 with PharmD degree. The PharmD. program, started in 2000 at Jordan University of Science and Technology, as a unique program in Jordan and the Middle East region.[191,192] It was designed to meet the increased need for clinical pharmacists and specialized pharmacy services in Jordan and other countries in the region.[191] Despite the continuous efforts to advance pharmacy education in Jordan, there is a little focus on patient care process skills.[191] Consequently, pharmacists in Jordan are still limited to dispensing and marketing medications and slowly expanding their practice to include more clinically oriented skills and responsibilities.[191,192] In a recent study, the majority of pharmacists in Jordan reported a clear understanding of the pharmaceutical care responsibilities. This includes the patient care process as one part of the pharmaceutical care. However, they reported a limited implementation of patient care process in their routine practice.[191] In this study, over 80% of pharmacists reported that lack of proper training as the main barrier to providing pharmaceutical care. Other barriers include difficulty in communicating with physicians and accessing to patient medical records.[191] Therefore, I predict great research opportunities in Jordan to advance pharmacy practice and education.

During my Ph.D. journey at the University of Alberta and working closely with Dr. Guirguis, I had the opportunity to learn about the pharmacy practice and education in Canada. I was also fortunate to learn about the patient care process and communication skills models (e.g., vital behaviours) in depth. I also had the opportunity to conduct research in this area and teach these skills at the University of Alberta. Being in debt to my supervisor, one of the pioneers in this

research area, for mentoring me over the years and share her knowledge with me, and to the Jordanian government (Yarmouk University) for sponsoring me to get my degree, I am aiming to transfer this knowledge to my home country and contribute in advancing pharmacy practice, research, and education to meet the global expectations of the pharmacy profession.

As a future pharmacy educator in Jordan, I aim to start teaching the patient care process, communication skills, and clinical reasoning approaches that should go along with this level of practice. I also aim to offer my knowledge and education to the Jordan Pharmaceutical Association to train pharmacists to implement the patient care process and work on identifying and resolving barriers to achieve this level of practice.

As for my research plans, I am expecting a long and exciting journey ahead of me. I want to start by transferring my training in conducting mixed methods and exploratory qualitative research methods (e.g. thematic) analysis to characterize current practice in Jordan. To my knowledge, these research methods are rarely used in pharmacy research in Jordan. The results of this research will help me design and implement appropriate interventions in education and practice and measure outcomes afterwards. I am also aiming to study clinical reasoning in Jordan over time using protocol analysis. This level of research will help me measure if I achieved my goals in teaching and implementing advanced pharmacy skills.

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Appendices

Appendix 1: The published version of Chapter 2

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Research in Social and Administrative Pharmacy ■ (2016) ■–■

RESEARCH IN SOCIAL & ADMINISTRATIVE PHARMACY

Original Research

How pharmacists check the appropriateness of drug therapy? Observations in community pharmacy

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Abstract

Background: In Alberta (Canadian province), the Chat Check Chart (CCC) model was developed to help pharmacists understand how patient care standards fit into routine practice. The CCC model outlines a process that covers the following: 1) Chart—asking three prime questions to gather information; 2) Check—perform pharmacotherapy workup by assessing prescription's indication, efficacy, safety and manageability; and 3) Chart—document findings of the pharmacotherapy workup.
Objectives: To characterize how pharmacist collect patient information and apply the pharmacotherapy workup when evaluating routine prescriptions in community pharmacy settings.
Methods: An observational study with a mixed methods analysis was employed. Participants were surveyed and audio-recorded talking with patients, as well as thinking aloud while evaluating medication therapy. Quantitative analysis was conducted to describe the proportion of time allotted to clinical or technical duties when using the 3 prime questions and pharmacotherapy workup in routine practice. A generic qualitative approach was conducted to describe how the pharmacists evaluated prescriptions and counseled patients.
Results: Nine pharmacists from five different pharmacy stores participated in this study. Fifteen recordings of consults and 14 think-alouds were eligible for analysis. Pharmacists allotted 16% of their think-aloud on clinical related issues for new and chronic medications, and the remainder on technical dispensing activities. All pharmacists checked if the medication was safe, but fewer than half checked if the prescription was indicated, effective, or useable (i.e., adherence). Pharmacists covered more content areas when checking the appropriateness for new prescriptions in comparison to chronic refills. Four overarching themes arose from the qualitative analysis: missed opportunities, absence of personalized assessments, reliance on routine pharmacist activities, and non-specific questions.
Conclusions: Pharmacists gathered insufficient clinical information to assess their patients' medication therapy, as they overly relied on the patients' profiles, asked patients non-specific questions, and missed

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patient cues. Routine activities appeared to shape practice including a bias against refill prescriptions and a focus on technical dispensing activities.

Keywords: Mixed methods; Patient assessment; Pharmacotherapy workup; Think-aloud; Consultation; Community pharmacy

Introduction

Over 40% of Canadians take prescription medications, and this number rises to 83% for those over 65 years of age.[1] One in seven adult Canadians has two or more chronic diseases, which often necessitates multiple medication therapy.[2] Polypharmacy – taking 5 or more medications – was at 11% for Canadians aged 45–64 and 30% for Canadians over 65 years of age.[1] Increasing the number of medications increases the risk of adverse drug reactions and subsequent hospitalization. A systematic review found that 4.6–12.1% of hospitalizations were due to drug-related problems (DRP).[3]

Pharmacists are well positioned to meet patients' health needs as the most accessible health care provider with expertise in medication management.[4] Pharmacists can apply the skills in pharmaceutical care to prevent DRPs, monitor medication therapy and optimize patients' medication therapy.[5] Pharmaceutical care is "the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life."[6] Pharmacists' provision of pharmaceutical care has been shown to have a positive impact on patient outcomes,[7–12] and improve economic outcomes.[13,14]

In the pharmaceutical care model, pharmacist's core cognitive function is assessing the appropriateness of a medication therapy for an individual patient. This is commonly known as the pharmacotherapy workup (PTW), whereby a pharmacist determines if a therapy is indicated, effective, safe, and manageable for a specific patient after gathering the required information.[5] This has also been referred to as the "Clinical Check."[15] Both gathering the information and completing the PTW for a patient are often referred to as the patient assessment portion of the pharmaceutical care.[5] The PTW defines pharmacists' unique cognitive contribution to patient care. Using the PTW as a part of pharmaceutical care has resulted in improved clinical outcomes in 83% of patients and over a million dollar health care saving.[16] However, research has not yet empirically characterized how pharmacists conduct the PTW in community pharmacies where medication dispensing often remains a part of practice.

Research has characterized patient assessment in professional nursing and medicine.[17] However, pharmacists have a distinct focus and training on medication appropriateness. Two studies empirically examined pharmacists' thought processes and suggested that pharmacists use a combination of structured reasoning and recognition of common patterns to solve simulated clinical cases.[18,19] The aim in this preliminary research is to advance pharmacy practice literature by assessing how community pharmacists assess medication therapy using direct observations.

In Alberta, community pharmacists have struggled with the practice change and reported that most of their practice time is allotted to dispensing activities.[20,21] For this reason, a partnership between a faculty member of the University of Alberta and the Alberta College of Pharmacists created a practical model to help pharmacists understand how the patient care fits into routine dispensing practice. The Chat Check Chart (CCC) model outlines a process in which pharmacists gather information (Chat), evaluate medications for appropriateness using the PTW (Check), and document patient care (Chart) using recognized tools or processes. Chat consists of three prime questions (3PQs) where the pharmacist asks three open-ended question to explore the patient's understanding about 1) the purpose of taking the medication (PQ1), 2) directions (PQ2) and 3) medication monitoring (PQ3). Again, Check consists of the PTW process. Chat is a brief data, assessment and plan (DAP) note format, and it is not routinely used in practice.[22,23] The Check Chat Chart model succinctly clarifies the standards of practice in Alberta, and is used to assess the quality of patient care. The Check Chat Chart model has increased pharmacists' self-efficacy and role beliefs toward assessment and documentation, as well as motivated

Table 1
Demographics and job characteristics of pharmacists

ID	Age range	Gender	Perception of store business	Years of practice	Work burnout[a] (mean, median)	Role conflict[b] (mean, median)
1100	<25	Female	Slow with busy times	2	1.5, 1.5	3.3, 3.0
1200	36–45	Female	Slow with busy times	6	1.0, 1.0	4.0, 3.5
2100	25–35	Female	Slow	7	1.0,1.0	3.9, 3.0
2200	25–35	Male	Slow with busy times	6	1.5, 1.5	4.0, 4.0
3100	36–45	Female	Steady	14	1.5, 1.5	3.5, 3.0
4100	46–55	Female	Busy	29	0.5, 0.5	2.4, 3.0
4200	25–35	Female	Busy with slow times	7	4.0, 4.0	2.5, 2.5
5200	56–65	Female	Busy with slow times	40	0.5, 0.5	1.0, 1.0
5300	25–35	Male	Steady	4	2.0, 1.5	4.5, 5.0
			Mean ± std dev	12.8 ± 13.0	1.5 ± 1.1 (median 1.5)	3.2 ± 1.1 (median 3)

[a] 6-point, Likert-type scale (0 = Not at all, 1 = Just a little, 2 = A moderate amount, 3 = Pretty much, 4 = Quite a lot, and 5 = A great deal).
[b] 7-point, Likert-type scale (1 = very strongly disagree, 2 = strongly disagree, 3 = disagree 4 = neutral 5 = agree 6 = strongly agree, and 7 = very strongly agree).

open question, a closed question or a question asking what the doctor said. In some recordings, pharmacists discussed the topics of the 3PQs with patients rather than asking questions, so that portion of the 3PQs coding was included and referred to these instances as given information. PTW elements were coded during the think-aloud portion of the audio recording. The incidence of each PQ and PTW element was counted as if occurred or not (i.e., zero or one). Repeated incidences for the same prescription were not counted. Since the sample did not have equal numbers of new prescriptions and refills, the percentage of incidences were used to compare the incidence of PQ and PTW elements. Percentage of incidence was calculated by dividing the incidence of each element by the total number of prescriptions (Tables 2 and 3).

Clinical and technical times were measured in seconds. Clinical times include when the pharmacist was discussing clinical related issues with patients (e.g., 3PQs, asking about medical history, allergies) or thinking aloud about clinical related issues (e.g., PTW, past medical history). Technical times include when the pharmacist was discussing technical issues (e.g., insurance, paying the bill) or thinking aloud about technical things (e.g., counting pills, labeling, and checking the prescriber's name). The clinical and technical times in seconds were divided by the total seconds of each recording to calculate the percentage of clinical and technical times.

MBN and a research assistant independently coded the recordings. Differences in coding were discussed and resolved by a third person (LMG) if necessary. Inter-rater reliability was assessed using Cohen's kappa. The kappa value for the two coders was 0.82, which indicates a good agreement between the two coders. Descriptive statistics were used to calculate the occurrence of the 3PQs and PTW.

Pharmacists' surveys were analyzed and overall median scores of constructs (i.e., work burnout and role conflict) were calculated by taking the mean of related questions for each construct separately.

Qualitative analysis

All instances where pharmacists discussed clinical issues were transcribed in both think-aloud and consultations. Transcripts were analyzed using a generic qualitative approach.[26,27] Transcripts were reviewed and coded for two purposes: 1) to describe how the pharmacists evaluated prescriptions and counseled patients and 2) to describe how the pharmacists used the 3PQs and PTWs in consultations and think-alouds, respectively.

Two authors (MBN, LMG) reviewed the audio recordings to get a sense of the whole and then independently identified relevant codes and formulated a general description to the use of each of the PQ and PTW. Based on these codes and descriptions, themes were generated through

Table 2
Incidence of pharmacists using PTW in think-alouds per prescription

	New Rx $N = 7$ (n/N%)	Refill (prior usage) $N = 13$ (n/N%)	Total $N = 20$ (n/N%)
Incidence of PTW 1 – indicated	$n = 1$ (14.3%)	0	$n = 1$ (5%)
Incidence of PTW 2 – effective	$n = 3$ (42.9%)	$n = 1$ (9.1%)	$n = 4$ (20%)
Incidence of PTW 3 – safe	$n = 7$ (100%)	$n = 13$ (100%)	$n = 20$ (100%)
Incidence of PTW 4 – manageable	$n = 3$ (42.9%)	$n = 8$ (61.5%)	$n = 11$ (55%)
Proportion of clinical time[a]	17.2% ± 3.6 Min = 15.1%, max 22.5%	16.5% ± 10.1 Min = 2.5%, max = 37.2%	16.4% ± 8.7 Min = 2.5%, max 37.2%
Proportion of technical time[b]	74.2% ± 13.3 Min = 59.5%, max = 85.8%	83.0% ± 10.4 Min = 60%, max = 97.1%	80.6% ± 11.4 Min = 59.5%, max = 97.1%

Abbreviations used: PTW, question to evaluate therapy; Rx, prescription; Min, minimum; Max, maximum.
[a] Clinical time: Moments where the pharmacist was thinking aloud about clinical issues including PTW elements (e.g., checking for drug allergies, interactions, and refill history).
[b] Technical time: Moments where the pharmacist was thinking aloud about technical things (e.g., counting pills, labeling, and checking the prescriber's name).

an interactive process of discussion and recourse to the data.

Results

Nine pharmacists participated in the study with an average of 12.8 ± 13.0 years of experience in practice, as represented in Table 1. Five pharmacy stores in Alberta, with one rural and four urban were included in the study. All the stores had a private counseling room. The pharmacists reported "a moderate amount" of work burnout (1.5 ± 1.1) and "disagreed" (3.2 ± 1.1) with having any role conflict (Table 1). The results of the think-alouds will be presented first then the consultations as pharmacists asked the 3PQs after the PTW in 13 out of 15 interactions.

Pharmacotherapy-work up analysis

Fourteen think-alouds were recorded and analyzed, four think-alouds were recorded for seven new prescriptions, and 11 think-alouds for 13 refills. The pharmacists spent almost 80% of their time on technical checking activities. The proportion of time for clinical and technical checking tasks was similar between new prescriptions and refills (Table 2).

Table 3
Incidence of pharmacists discussing 3PQs in consultations per prescription

	New Rx $N = 7$ (n/N%)	Prior usage $N = 14$ (n/N%)	Total $N = 21$ (n/N%)
Incidence of PQ1 – purpose	$n = 5$ (71.4%)	0	$n = 5$ (23.8%)
Incidence of PQ2 – directions	$n = 6$ (85.7%)	$n = 5$ (35.7%)	$n = 11$ (52.4%)
Incidence of PQ3 – Monitoring	$n = 6$ (85.7%)	$n = 5$ (35.7%)	$n = 11$ (52.4%)
Proportion of clinical time[a]	38.9% ± 21.2 Min = 0, max = 63.6%	20.9% ± 22.4 Min = 0, max = 28.8%	27.2% ± 23.1 Min = 0, max = 63.3%
Proportion of technical time[b]	60.8% ± 21.1 Min = 36.4%, max = 99.5%	76.8% ± 24.6 Min = 34.8%, max = 99.9%	71.1% ± 24.1 Min = 34.8%, max = 99.9%

Abbreviations used: PQ, prime question; Rx, prescription; Min, minimum; Max, maximum.
[a] Clinical time: Moments where the pharmacist was discussing clinical issues with patients, such as asking about medical history, allergies, medication history.
[b] Technical time: Moments where the pharmacist was discussing technical aspects, such as insurance, social conversation, and paying the bill in consultation.

Table 4
Detailed description and qualitative themes for each audio recording

RPh #	Pt #	Type of Rx	PTW 1	PTW 2	PTW 3	PTW 4	PQ1	PQ2	PQ3	Qualitative themes
1100	Pt1	Refill			X	X		X	X	-Missed opportunity (assumption) -Reliance on routine (refill bias, hardcopy check)
	Pt2	New Rx		X	X	X	X	X	X	-Missed opportunity (assumption) -Depersonalized assessment (profile & product focused) -Reliance on routine (hardcopy check, reward card) -Nonspecific questions (any questions)
1200	Pt1	Refill			X	X			X	-Missed opportunity (assumption, instinctive judgments) -Depersonalized assessment (profile & product focused) -Reliance on routine (hardcopy check, refill bias, reward card) -Nonspecific questions (any questions)
	Pt2	New Rx			X	X				-Missed opportunity (assumption, instinctive judgments, missed patient cues) -Reliance on routine (hardcopy check) -Depersonalized assessment (almost completely technical)
2100	Pt1[a]	New Rx			X	X		X	X	-Missed opportunity (assumption, missed patient cues) -Depersonalized assessment (almost completely technical, profile & product focused) -Reliance on routine (hardcopy check)
2200	Pt1	Refill	n/a	n/a	n/a	n/a			X	-Missed opportunity (assumption, missed patient cues) -Reliance on routine (refill bias, reward card) -Nonspecific questions (still okay)
	Pt2	Refill	X		X	X		X	X	-Missed opportunity (assumption) -Reliance on routine (hardcopy bias, refill bias, reward card) -Nonspecific questions (any questions)
	Pt3	Refill			X	X				-Missed opportunity (assumption, instinctive judgments) -Reliance on routine (hardcopy check, refill bias) -Depersonalized assessment (profile & product focused, almost completely technical) -Nonspecific questions (still okay)
3100	Pt1	Refill 1			X	X				-Missed opportunity (assumption)
		Refill 2		X	X					-Depersonalized assessment (profile & product focused, almost completely technical) -Reliance on routine (reward card) -Nonspecific question (any questions, still okay)
	Pt2	Refill 1			X	X				-Missed opportunity (assumption)
		Refill 2			X	X				-Depersonalized assessment (profile & product focused, almost completely

(*Continued*)

Table 4 (*Continued*)

RPh #	Pt #	Type of Rx	PTW 1	PTW 2	PTW 3	PTW 4	PQ1	PQ2	PQ3	Qualitative themes
										technical) -Reliance on routine (hardcopy check, reward card, refill bias) -Nonspecific question (any questions, still okay)
4100	Pt1	New Rx 1			X		X	X	X	-Missed opportunity (assumption, missed Pt cues) -Depersonalized assessment (profile & product focused) -Reliance on routine (hardcopy check, reward card) -Nonspecific questions (any questions)
		New Rx 2			X		X	X	X	
		New Rx 3			X		X	X	X	
4200	Pt1	Refill 1			X					-Depersonalized assessment (profile & product focused, almost completely technical) -Reliance on routine (hardcopy check, reward card) -Nonspecific questions (any questions)
		Refill 2			X					
5200	Pt1	Refill			X			X		-Missed opportunity (assumption, missed Pt cues) -Depersonalized assessment (profile & product focused, almost completely technical) -Reliance on routine (reward card, refill bias)
5300	Pt1	New Rx		X	X		X	X	X	-Missed opportunity (assumption, missed Pt cues) -Depersonalized assessment (profile & product focused) -Reliance on routine (hardcopy check, reward card) -Nonspecific questions (any questions)
	Pt2[a]	Refill 1 (dose adjusted)			X	X		X	X	-Missed opportunity (instinctive judgments) -Depersonalized assessment (profile & product focused)
		Refill 2			X			X		-Reliance on routine (hardcopy check, reward card, refill bias) -Nonspecific questions (any questions)

Abbreviations used: RPh, pharmacist; Pt, patient; Rx, Prescription; PQ, prime question; PTW, question to evaluate therapy.

[a] The only two cases where pharmacists asked PQs prior to think-aloud.

No pharmacist explicitly checked for prescriptions using all four elements of the PTW (Table 4). In 13 of the 15 think-alouds, pharmacists gathered clinical patient information (i.e., 3PQs) after the prescription was checked. Pharmacists used information provided in the profile such as refill intervals, medication allergies, interactions, and the presence of medical conditions to check for clinical appropriateness.

There was one instance of a pharmacist checking PTW1 (i.e., indication) (Table 5). Pharmacists checked for PTW2 (i.e., efficacy) in three think-alouds: two for new prescriptions and one refill. They checked if the dose appeared to be in the standard range for two new fills or whether the patient had used sufficient doses to be effective since the last refill.

Pharmacists checked for prescription PTW 3 (i.e., safety) in all think-alouds (21 instances), and in almost all cases pharmacists checked for safety by checking for drug interactions, allergies, and drug disease interactions as per information on patient profile (Table 5).

Table 5
Description of coded 3PQs and PTW and quotes

Definition	Description of coded instances	Example
PTW1 Indication	RPh assesses if medication is indicated for individual patient (1 instance)	"So for the three medications that I am for her, I am checking last fill date to see if they were used appropriately, two of them are migraine medications and one is a nasal spray" (RPh 2200)
PTW2 Effective	Check against standard dose (3 instances)	"Patient is one year old given 125 mg of [amoxicillin] 3 times a day, familiar with it. That's a standard dose" (RPh 5300)
PTW3 Safe	All RPhs checked for safety (21 instances): drug interactions, allergies, and drug disease interactions on patient profile.	"Check drug allergies, and then interactions, medical conditions." (RPh 4200)
PTW4 Manageable	Patients manage to take the medication (10 instances)	
	For refills, RPhs checked for patients' adherence with fill internals (7 instances)	"She got a 3 months or 90 day supply 89 days ago, so compliance is fabulous" (RPh 3100)
	For new prescriptions (3 instances), RPh added auxiliary labels to finish all or noted refills remaining.	"I will add an auxiliary label ... finish all medication" (RPh 1100)
PQ1 Purpose	Leading questions (5 instances) (i.e., declarative) to verify indication	"Is it for a chest infection, throat infection ... strep throat? Pt: Yeah." (RPh 1100)
	RPh giving information (1 instances)	"Doctor gave you something just in case if you develop yeast infection." (RPh 4100)
PQ2 Directions	Questions: (10 instances)	
	RPh asking closed questions (2 instances)	"But I think you are quite aware of how to use it right?" (RPh 2100)
	RPh asking "Did the doctor tell you?" (4 instances)	"Did the doctor give you specific instructions for how long? Pt: He just said to use it." (RPh 4100)
	RPh asking closed and open questions (1 instance)	"So do you just kind of alternate with these, or how do you use them" (RPh 2200)
	Pt asking questions (3 instances)	"RPh: Do have any questions or concerns? Pt: Yah, so since it is half way through the day, how does the three doses work" (RPh 5300)
	RPh giving information (8 instances)	"RPh 5200: So as before, one tablet one a day, swallow it whole. Pt: Um hum, um hum" (RPh 5200)
PQ3 Monitoring	Negative outcomes (i.e., adverse drug reactions) (8 instances)	
	RPh telling (6 instances)	"Now since the dose has increased, there is a possibility that you might have side effects because of the increase ..." (RPh 5300)
	RPh asking closed (2 instances)	"Has he had any problems with, um, like weird muscle pain or muscle weakness ...?" (RPh 2200)
	Positive outcomes of therapy (i.e., efficacy) (3 instances)	
	RPh telling (2 instances)	"Time frame, give it couple of days but really by the fourth or fifth dose you should notice an improvement in your symptoms." (RPh 1100)
	RPh asking closed questions (1 instance)	"Pt: Sometimes I don't take it every night. Yeah okay. Do you find you are completely sleepless when you do that?" (RPh 1200)

Abbreviations used: RPh, pharmacist; Pt, patient; PQ, prime question; PTW, question to evaluate therapy.

Six pharmacists checked for PTW4 (i.e., adherence) to prescriptions in 11 TAs (11 instances), eight for refills, and three for new prescriptions. For refills, pharmacists checked for patients' adherence by checking the patients' profile for refill intervals (Table 5). For new prescriptions, they added auxiliary labels to remind patients to finish all medication for new acute prescriptions or about the next refill for the repeated ones.

Consultations

Sixteen consultations were recorded; one consultation was excluded because it was incomplete. Fifteen consultations with 21 prescriptions were analyzed. Five consultations were for seven new prescriptions and the remaining ten were for 14 chronic refills or previously used prescriptions (Table 3).

Overall, pharmacists allotted 27% of total consult time discussing clinical issues with their patients. The amount of clinical time for new prescriptions was nearly double the clinical time for refills (Table 3).

Pharmacists discussed at least one of the 3PQs topics in 61.9% of interactions (Table 3). Pharmacists discussed PQ1 on the purpose of medication in five out of the seven new prescriptions, mainly using leading closed questions (i.e., declarative questions) to verify the potential use of new medications (Table 5). In this way, pharmacists displayed their knowledge of the medication before double checking for accuracy with the patient.

Pharmacists discussed PQ2 (i.e., direction) & PQ3 (i.e., monitoring) for new prescriptions more frequently than for refills (Table 2). PQ2 was initiated by pharmacists giving information on the directions (8 instances), and by pharmacists asking questions or patients asking questions (7 instances). Pharmacists asked three types of questions: 1) an inquiry of what did the doctor say (4 instances) 2) closed questions (2 instances) and 3) one open question (Table 5).

Pharmacists discussed PQ3 in half of consultations (Table 3). They focused on adverse reactions, mainly in the form of giving statements (i.e., 6 instances) rather than questions (i.e., 2 instances; Table 5). Pharmacists discussed benefits and positive outcomes of therapy in 3 instances. In the 21 prescriptions, pharmacists asked or discussed no PQ in eight prescriptions (7 refills and 1 new), one PQ in four prescriptions (all refills), two PQs in four prescriptions (3 refills and 1 new), and three PQs in five prescriptions (all new).

Qualitative

Four overarching themes described how pharmacists evaluated prescriptions and counseled patients (Table 4): *Missed opportunities, Depersonalized assessments, Reliance on routines* and *Nonspecific questions*.

Missed opportunities

This overarching theme appeared primarily but not strictly in think-alouds and included the following three sub-themes: *Assumptions, Missed patient cues* and *Instinctive judgments*.

Assumptions. Pharmacists seemed to check for prescription appropriateness using incomplete information and act on assumptions or hunches. Two pharmacists assumed that the dose was appropriate without checking the indication based their perception that "it is pretty commonly used that way" (RPh 1200) or being "familiar with it, it is a standard dose" (RPh 5300). One pharmacist assumed that the patient knew how to apply a newly prescribed cream.

(RPh 2100/Pt):

RPh: "So is this a new medication for you?"

Pt: "Yes."

RPh: "But I think you are quite aware of how to use it, right?"

Pt: "Uh, you can remind me if you like"

Missed patient cues. Pharmacists often missed some of the patients' cues. Some patients gave cues that indicated their confusion, uncertainty, or hesitation about their medications; these cues could be inferred from their tone of voice or behaviors. In the previous example (RPh 2100), there was hesitation in the patient's response about knowing how to use his medication "Uh, you can remind me if you like." Pharmacist (2100) missed that cue and did not tell the patient how to use his medication.

Instinctive judgments. No pharmacist made an explicit check all of the four elements of PTW. In some places, pharmacists seemed to make a complete assessment of prescriptions instinctively without actually verbalizing it. In one audio recording, the pharmacist checked for the safety element of PTW and decided quickly that it

"looks good": "no significant interactions to check; everything looks good" (RPh 5300).

Depersonalized assessments

This overarching theme included two sub-themes: *Profile & product focused* and *Almost completely technical.*

Profile & product focused. In most cases, pharmacists checked the prescriptions' appropriateness using patients' profile information on the computer before discussing medications with patients. Pharmacists thus may not be aware of indication for new prescriptions and efficacy and adverse events for refills. In some cases, pharmacists started new profiles for new patients and did not gather information on other medications or medical conditions. However, pharmacists explicitly checked for drug-drug and drug disease with these incomplete profiles. In one audio recording, a pharmacist checked if the patient was getting the full benefit of his inhaler by checking his profile and did not confirm therapy outcomes with the patient later in the consultation:

Almost completely technical. Some consultations were completely technical and pharmacists did not counsel the patient at all.

(RPh 4200/Pt):

RPh: "So your total is 74.55 and do you have [rewards] card?"

Pt: I don't but my mom does.

RPh: "That's alright. I just need you to sign there that you picked it up today."

RPh 5200 and 3100 were also solely technical in both consultations and think-alouds to the extent that the patients' medications or medical conditions could not be identified. Both pharmacists stated the quantities dispensed and refills remaining.

Reliance on routines

Pharmacists appeared to have common routines that shaped their practice. Three sub-themes were identified under routines: *Hardcopy check, Refill bias,* and *Rewards card.*

Hardcopy check. Most pharmacists assessed appropriateness in a routine manner. Pharmacists could be heard systematically reviewing interactions, allergies, and refill intervals on the prescriptions' hardcopy (i.e., computer printout). The checking procedure associated with the hardcopy was focused on technical items mainly (e.g., correct doctor and patient names) and clinical items related to safety and refill intervals. Pharmacists focused on the hardcopy elements rather than patients' clinical experiences or outcomes. In one extreme example, one pharmacist followed the same routine with test strips to check blood sugars and stated, "I check interactions, allergies, and medical conditions, none of which I think is significant" (RPh 2200).

Refill bias. Pharmacists typically checked for refill safety and refill intervals. There were no instances that captured pharmacists evaluating the effectiveness of a refill. Pharmacists verbalized this refill bias, "This is a refill for [patient name]. I am not too concerned about counselling her on usage or dosing or storage because I think she is familiar with that" (RPh 2200).

Another example of reliance on routines was the *Rewards Cards* or loyalty program cards (i.e., cards made by the store that allow customers to get price reduction or special promotions). Pharmacists asked for the patients' reward cards in 11 of 15 consultations. One patient appeared to be used to this routine in consultations.

(RPh 5300/Pt):

RPh: Did you have any questions or concerns on it today?

Pt: "No, I am just looking for my [rewards] card"

Nonspecific questions

In almost every consultation, pharmacists used broad, general, or *Nonspecific Questions* to check for patient concerns or understanding. In some recordings, only non-specific questions characterized the consultations. *Nonspecific Questions* included two types of questions or themes: *Any Questions?* and *Still Okay?* Patients generally responded with "No, I don't have any questions" or "Yes, I am still okay," except on two occasions (RPh 1100, 5300) where the patients had a question related to directions (PQ2).

In some refill consultations, pharmacists checked if the patients had any issues with their medications by asking if they were *Still Okay* with their medications. RPh 2200 used this type of question when he was counseling a patient about her and her husband's medications.

(RPh 2200/Pt):

RPh: "And are you okay with this one?"

Pt: "Yes I am"

RPh: "And is he okay using all of these?"

Pt: "Yes he is"

RPh: "Any concerns with them?"

Pt: "Nope. Nope, he is okay."

In some cases, pharmacists asked "any questions or concerns" upfront in the consultations for agenda setting purposes, and if the patients did not have any concerns, then pharmacists would bring their own agenda.

(RPh 1200/Pt):

RPh: "Did you have any questions or concerns?"

Pt: "Nope. I have been taking it for probably 5 years."

RPh: "Okay, have you talked to your doctor about stopping it …. "

Pharmacists also used non-specific questions to end consultations. The following consultation, typifies how pharmacists use *Any Questions* to signal an end to the conversation.

(RPh 3100/Pt):

RPh: "Any questions or concerns?"

Pt: "No."

RPh: "Everything is good?"

Pt: "Everything is"

RPh "… Any questions give us a shout."

Discussion

A combination of observations and think-aloud technique were used to characterize how pharmacists gather information and evaluate medication appropriateness in a community pharmacy setting.

Pharmacotherapy-work up

In Alberta, pharmacists are legally responsible for monitoring drug therapy and determining the appropriateness of each prescription they dispense.[40] In this study, all pharmacists checked if the medication was safe, but not all explicitly checked to see if the prescription was indicated, effective, safe, and manageable (i.e., adherence).

The prescription checks in this study were predominately technical and product focused (i.e., dispensing). Similarly, Albertan pharmacists have reported their roles to be mainly product focused.[20,21] Similar studies used indirect measure of PTW reported that the majority of the pharmacists' time is devoted to dispensing medications,[41–43] and they allotted less than 11% to prescription monitoring and checking for appropriateness.[44,45]

Consultations

Pharmacists in this study discussed the medication's purpose, directions, and monitoring for less than 53% of all types of prescriptions. In consultations, pharmacists tend to be more focused on technical issues, as reported in several studies.[46–50] Emmerton and Jefferson found that a range of 17.6–46.9% of pharmacists' time is devoted to "professional" activities, while the rest is devoted to "business" and "non-productive" activities.[51] Similar studies reported that pharmacists spend less than 49% of their time on "professional activities."[44,45,52]

Pharmacists spent twice as much time on discussing clinical issues for new medications compared to refills (39% vs. 21%, respectively). Pharmacists discussed or queried the medication's purpose, directions, and monitoring for 71% of new medications, but did so for less than 36% of chronic refills. Previous studies reported similar findings; pharmacists asked patients clinical related questions in 39% of new prescriptions compared to 26% for refills.[53] In a review study, pharmacists' counseling for new prescriptions varied from 29% to 69%.[54]

Qualitative themes

Four overarching themes characterized the pharmacists' transcripts: *Missed opportunities, Depersonalized assessments, Reliance on routines* and *Nonspecific questions*.

Missed opportunities

This study suggests that pharmacists missed the opportunity to gather information or encourage the patient to participate. Yet, pharmacists often list a lack of patient information as a barrier to detecting drug related events.[19] Research in pharmacy and medicine suggests that pharmacists need to engage patients in consultations not only by asking questions, but by phrasing questions in a way that encourages the patient to participate.[33,55]

Pharmacists' assumptions and their holistic assessments of prescriptions may represent intuition or automaticity in making decisions as described by Hoffman.[56] Intuition could explain why pharmacists in this study signed off prescriptions before making explicit assessing the four elements in the PTW. Intuitive thinking generates decisions automatically without effort and with

low or no level of consciousness possibly represents a sign of expertise.[57] On the other hand, intuitive practice can lead to premature closure where decisions are made before verification or overconfidence bias: a tendency to believe that individuals know more than they do and act on incomplete information instead of carefully collected cues.[58]

Depersonalized assessments

Pharmacists' reliance on patients' profiles rather than communicating with patients possibly resulted in pharmacists giving unsolicited information to patients. This tendency has been reported elsewhere.[33,59–61] In this study, pharmacists predominantly used close-ended questions as noted in the pharmacy literature since the 1990s.[36,53,62,63] Pharmacists focused on reviewing instructions on the vial and the common side effects rather than asking questions and making assessments.[64]

Reliance on routines

In think-aloud data, pharmacists followed a routine check for safety and refill intervals and they were less likely to check for prescriptions indication and effectiveness. Reliance on technical dispensing routines may hinder pharmacists from detecting drug related problems related to patients' experience and consequently increase the rates of patients' morbidity and mortality, in addition to the huge economic burden on the health care system.[65–68]

Pharmacists did not routinely check appropriateness for refills in think-alouds. Pharmacists may have viewed refills as routines unless something changed about the prescription (e.g., dose increased). Witry reported that the routine nature of refills acts as a barrier for refill counseling,[46] and Guirguis and Lee reported that pharmacists believe they give priority to new patients or patients with new prescriptions.[25] Patients have also been found to be less interested in engaging in a dialogue about their refills when compared to first-time prescriptions.[69,70]

In previous studies, pharmacists reported a lack of time and workload as barriers for refill counseling.[46,60,71] Lack of time and store business did not appear to be the barrier as pharmacists in this study reported that their stores' busyness to be "steady" on average. This situation suggests that the routine nature of refills, not time pressures, to be the main barrier for failing to make a complete assessment for refills.[25,46]

Nonspecific questions

Pharmacists tended to ask non-specific questions (e.g., do you have any questions or concerns?) in place of more specific questions such as the 3PQs. While pharmacists are encouraged to start in an open manner, specific questions are required to monitor drug therapy. Witry suggested that pharmacists may perceive that they have insufficient information to ask more specific or meaningful questions.[64] Patients who experience depersonalized consultations may become disinterested in talking to their pharmacists about refills and prefer an automated prescription delivery system over a regular pick-up counter.[70]

The results of this study indicate that pharmacists tended to ask declarative (leading) questions or sometimes vague questions rather than asking the 3PQs in the form of open questions. Pharmacists want to appear knowledgeable about medications and thus ask declarative questions to "save face."[24] Nguyen suggested that declarative statement could function as a question where used by pharmacy interns who sought information about the purpose of the therapy.[59]

Future research on clinical decision making in pharmacy may benefit from a combination of prospective think-aloud and retrospective think-alouds to increase the depth and completeness of information collected as well as protocol analysis for a more inductive interpretation of pharmacists' clinical decision making.[29] Ultimately, research should evaluate the link between pharmacists clinical decision making and patient outcomes. Pharmacists practice research should also investigation methods to address pharmacists' bias toward new refills and reliance on technical routines.

Limitations

This study has a few limitations. First, the sample was insufficient to make generalizations about the findings beyond the participating pharmacists. In this study, pharmacists completed the think-aloud sessions with minimal real-world interruptions and were not prompted or guided by the researcher. However, a real-world setting may have introduced additional variability in the data.[56]

The think-aloud technique is prone to reactivity; pharmacists may perform better than usual because of a more structured working process or perform worse due to the double workload.[72,73]

Think-aloud and consultation recordings are susceptible to one type of reactivity (i.e., the Hawthorne effect); where pharmacists or patients may have modified or improved their behaviors as they were aware they were recorded. If the Hawthorne effect played a role in the quality of this study's results, pharmacists' actual patient care process usually has fewer PTW elements than reported.

Another limitation was the incompleteness of verbal reports due to the absence of interviews or retrospective think-alouds. It was difficult to determine if pharmacists were using intuitive approaches or they simply stopped verbalizing their thoughts which may preclude definite conclusions. This study used audio recordings and non-verbals were not captured. Finally, selection bias was a limitation in this study as pharmacists were responsible for the recruitment of patients from their practice, which may have led to bias within the sample.

Conclusion

Community pharmacists focused their attention on checking medication safety and providing information to patients with new prescriptions. Pharmacists gather insufficient clinical patient information to assess medication therapy, as they overly relied on computer profiles, asked patients non-specific questions, and missed patient cues. Routine activities appeared to shape practice, including a bias against refills prescriptions and a focus on technical dispensing activities. Future research on pharmacists' assessment skills should attend to the role of routines and the physical environment on patient care in community pharmacies.

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"looks good": "no significant interactions to check; everything looks good" (RPh 5300).

Depersonalized assessments

This overarching theme included two sub-themes: *Profile & product focused* and *Almost completely technical.*

Profile & product focused. In most cases, pharmacists checked the prescriptions' appropriateness using patients' profile information on the computer before discussing medications with patients. Pharmacists thus may not be aware of indication for new prescriptions and efficacy and adverse events for refills. In some cases, pharmacists started new profiles for new patients and did not gather information on other medications or medical conditions. However, pharmacists explicitly checked for drug-drug and drug disease with these incomplete profiles. In one audio recording, a pharmacist checked if the patient was getting the full benefit of his inhaler by checking his profile and did not confirm therapy outcomes with the patient later in the consultation:

Almost completely technical. Some consultations were completely technical and pharmacists did not counsel the patient at all.

(RPh 4200/Pt):

RPh: "So your total is 74.55 and do you have [rewards] card?"

Pt: I don't but my mom does.

RPh: "That's alright. I just need you to sign there that you picked it up today."

RPh 5200 and 3100 were also solely technical in both consultations and think-alouds to the extent that the patients' medications or medical conditions could not be identified. Both pharmacists stated the quantities dispensed and refills remaining.

Reliance on routines

Pharmacists appeared to have common routines that shaped their practice. Three sub-themes were identified under routines: *Hardcopy check, Refill bias,* and *Rewards card.*

Hardcopy check. Most pharmacists assessed appropriateness in a routine manner. Pharmacists could be heard systematically reviewing interactions, allergies, and refill intervals on the prescriptions' hardcopy (i.e., computer printout). The checking procedure associated with the hardcopy was focused on technical items mainly (e.g., correct doctor and patient names) and clinical items related to safety and refill intervals. Pharmacists focused on the hardcopy elements rather than patients' clinical experiences or outcomes. In one extreme example, one pharmacist followed the same routine with test strips to check blood sugars and stated, "I check interactions, allergies, and medical conditions, none of which I think is significant" (RPh 2200).

Refill bias. Pharmacists typically checked for refill safety and refill intervals. There were no instances that captured pharmacists evaluating the effectiveness of a refill. Pharmacists verbalized this refill bias, "This is a refill for [patient name]. I am not too concerned about counselling her on usage or dosing or storage because I think she is familiar with that" (RPh 2200).

Another example of reliance on routines was the *Rewards Cards* or loyalty program cards (i.e., cards made by the store that allow customers to get price reduction or special promotions). Pharmacists asked for the patients' reward cards in 11 of 15 consultations. One patient appeared to be used to this routine in consultations.

(RPh 5300/Pt):

RPh: Did you have any questions or concerns on it today?

Pt: "No, I am just looking for my [rewards] card"

Nonspecific questions

In almost every consultation, pharmacists used broad, general, or *Nonspecific Questions* to check for patient concerns or understanding. In some recordings, only non-specific questions characterized the consultations. *Nonspecific Questions* included two types of questions or themes: *Any Questions?* and *Still Okay?* Patients generally responded with "No, I don't have any questions" or "Yes, I am still okay," except on two occasions (RPh 1100, 5300) where the patients had a question related to directions (PQ2).

In some refill consultations, pharmacists checked if the patients had any issues with their medications by asking if they were *Still Okay* with their medications. RPh 2200 used this type of question when he was counseling a patient about her and her husband's medications.

(RPh 2200/Pt):

RPh: "And are you okay with this one?"

Pt: "Yes I am"

RPh: "And is he okay using all of these?"

Appendix 2 Simulated case

Case summary:

Simulated patient enters the pharmacy with a new prescription of Candesartan 16 mg, the patient is new to the pharmacy and has a history of hypertension and dyslipidemia. The patient was experiencing dry cough with previously prescribed medication (Ramipril 10 mg) so his physician switched him to a different class. The patient reports that he tried OTC cough preparation but it did not work. The patient appears to be hesitant to take the new medication, this comes out when the SP says that he is afraid that the new medication will cause the cough too.

Main Drug Related Problem(s)

SP has just been prescribed Candesartan 16 mg for his hypertension by his family physician. SP was on Ramipril 10 mg before and his doctor switched him to ARB due to dry cough caused my Ramipril. SP is not sure if the new medication will cause the same problem or not and he is hesitant to take it.

1. Scenario:

a. Opening statement from SP

"Hi, can I please have this prescription filled?"

b. Location/setting of Encounter

- Community Setting

c. Type of encounter (e.g., new patient, refill)

- New prescription, no patient profile on computer

d. **Drug coverage/Insurance**

- Pays CASH and submits receipts to plan

3. Patient History

a. Chief complaint

- Dry cough caused by his medication, this has been going on for weeks now and his doctor switched him to a different class of medication to stop the cough

b. Current medical problems:

- Dry cough

c. Relevant past medical history:

- Dyslipidemia (3 years) – last 2 years patient has had LDL <2, stable
- Hypertension (3 years) – self monitoring at a different pharmacy, BLOOD PRESSURE Average 125/75mmHg, BLOOD PRESSURE when diagnosed was 150/87

d. Medication List

New prescription:

- Atacand (Candesartan) 16mg QD (for hypertension, circular pink tablet)

Current medications:

1- Lipitor (atorvastatin) 20mg QHS (for dyslipidemia, oval white tablet)

2- Altace (Ramipril) 10 mg QD (for hypertension, white flat tablet)

OTC:

Benylin DM dry cough PRN (for the dry cough)

e. What information will patient give about medications

Patient has no problems with taking medication (can swallow pills and adherent). Patient is experiencing no side effects with medication. Patient reports that the physician told him the

cholesterol was fine and his blood pressure at doctor's office was 123/72mmHg.

f. Relevant social history:

Ex-smoker (3 years ago, 15 cig/day).

Drinks alcohol socially (1 drink/week).

Has a cup of coffee every morning.

g. Relevant family history:

Father passed away with heart attack (age 55).

Mother has hypertension (diagnosed 10 years ago)

h. Allergies:

Penicillin – Does not know, his parents told him

i. Summary of timeline:

Patient was diagnosed with hypertension 3 years ago, he was on water pill (thiazide

Diuretic) hydrochlorothiazide 25 mg but the patient experienced hypokalemia so his doctor put him on Altace 10 mg 6 weeks ago, about a week later the patient started to experience dry cough, he tried OTC cough preparation but did not work, and he saw his doctor today and put him on Atacand. "My potassium went low, so my doc changed the meds"

a. Attitude/Agenda:

Friendly. Not in a rush.

b. Non-verbal behaviours:
Coughs PRN during encounter.
c. Physical symptoms:

Symptoms – Cough few times during the encounter
Characteristics – dry cough, not productive
History/onset – started 5 weeks ago

d. Psychological symptoms

Worried and embarrassed from the nonstop coughing

e. Possible Q&As

1. Have you tried anything for the cough?

"I have tried over the counter cough syrup and it doesn't seem to be working"

2. Do you have any questions or concerns? "At the end of the interaction if the pharmacist does not talk about it"

"when should I stop taking the Altace?"

f. Any specific questions the patient should ask?

"Will the new medication cause the same problem? I am afraid to have this cough forever" This comes out when the pharmacist asks the patient if he has any questions or concerns about the prescription at the very beginning or when the pharmacist goes through expected side effects. You must bring up at end if the pharmacist does not bring it up.

Summary table for opportunities that pharmacists are expected to assess.

Patient Concern	Patient wanted to stop the dry cough triggered by Ramipril, and was not sure when to start taking Candesartan and stop Ramipril.
Indication	Candesartan is indicated for the simulated patient as he is diagnosed with hypertension and has been blood pressure lowering medication for a while.
Effectiveness	Candesartan is expected to be effective for this patient as his blood pressure was previously controlled with Ramipril, and the Candesartan dose is effective.
Safety	Candesartan is also safe for this patient, no contraindications, no allergies, and no drug interaction. It is possible that dose might be a high dose to start with, therefore, the patient needs to be advised to watch for side effects such as dizziness, and hypotension.
Manageable	The patient should not have compliance issues with the Candesartan since it is a direct replacement from what he was taking originally. It is the same dose and frequency as Ramipril and the patient did not have compliance problems with Ramipril. The only issue the patient had with Ramipril was the dry cough and Candesartan should not cause the dry cough that the patient experienced with Ramipril.

Appendix 3: Numbering system

Numbering system for think-aloud segments (*pharmacist ID/ transcript ID/ question number/ line number/ segment number)*

- Pharmacist ID is a three-digit number that represents the pharmacy store number and pharmacist number. Our sample came from eight different stores and we recruited two pharmacists from each store, except for Store #6, from which we recruited three pharmacists. Example: pharmacist ID 301 represents Store # 3 and Pharmacist number 01.
- Transcript ID: In the protocol analysis we evaluated two types of transcripts: think-aloud and retrospective protocols. The think-aloud transcript ID is 1, and the retrospective transcript ID is 2.
- Question Number: In the retrospective protocol we asked pharmacists five questions. Each question was given a number (1: What was important for this patient; 2: How did you decide that the medication is going be safe?;, 3: How did you decide that the medication is indicated?; 4: How did you decide that the medication is going to be effective 4; and 5: How did you decide that the patient is going to adhere to therapy?). In the think-aloud the pharmacists were given a task and not asked any questions. For that reason, we gave all questions in the think-aloud the number 1.
- Line Number: All transcripts lines were numbered prior to any coding. We used line numbers to track the coded segments. Each coded segment was assigned a line number based on its occurrence in the transcript.
- Segment Number: Each segment was assigned a number based on its occurrence in the transcript. The segment number is a continuous number all the way through the transcripts.

Appendix 4: List of operators and corresponding definitions and examples.

Operator	Definition	Example from CTA	Example from RTA	Source
Act	A description of what pharmacists are doing or thinking of doing. This operator included all action except for the following three:	" so now we are going to fill the prescription"	"so telling to stop the other medication"	This definition came from Hoffman's work.[102] a similar definition was described by Jones et al. however, their definition was broad and general as they mixed it with "explain" and making interventions.[38] We used Hoffman's definition as it is more specific and fits more with our data set.
• **Verify**	Confirmation of accuracy of a specific fact.	" Cross-reference if there's no license on there, at least cross-reference to make sure it's the correct phone number"	"also to confirm that they know how and that they do have their own blood pressure monitor at home"	This operator was adopted from other studies in nursing.[102,170] Hoffman described it as "evaluation", while Higuchi and Donald described as "verification". We adapted this to fit in with pharmacists practice as they routinely check and verify information on prescriptions for accuracy
• **Plan**	Pharmacists describing a step that will be taken in the future to achieve a	"so we will do a follow up call after they have started their medication"	"That's why we can have follow-up with them in the future if it's effective or not"	We adapted this operator from Lamond et al. They defined it as "organization of the activity/process to achieve goal"[193]. We

		care or monitoring plan.			adapted this definition to describe the care plan that pharmacists recommend or follow-up plans.
	• **Collect**	Gathering more information from patient, electronic records, and drug information resources.	"so I'll also ask him too when he comes in to just make sure that he's not taking any other medication that is not on this PharmaNet record"	"I asked him what he was using it for"	This operator was described in nursing literature as gathering information from patient, tests, or examination.[38,176,194] In our data set, we noticed that pharmacists rely on external resources, such as electronic health records, and drug information resources. Therefore, we adapted the definition to fit in with our data.
	• **Exit**	Pharmacists giving cue that they are done checking the prescription and they are ready to end the concurrent think-aloud session.	"and that's it"	N/A	This operator was used by Wong and Chung.[176] They did not provide a definition for this operator, but it can be inferred that it indicates the end of the session. Ericsson and Simon used a similar term "end" for the same purpose.[19]
Infer		Making an assessment based on connecting information or evidence. This	" Well, from what he said, he had high blood pressure"	"just because if the patient has already been using the Altace and the issue that they had was dry cough"	The definition came from Hoffman's work,[2] but it was also used in other clinical reasoning

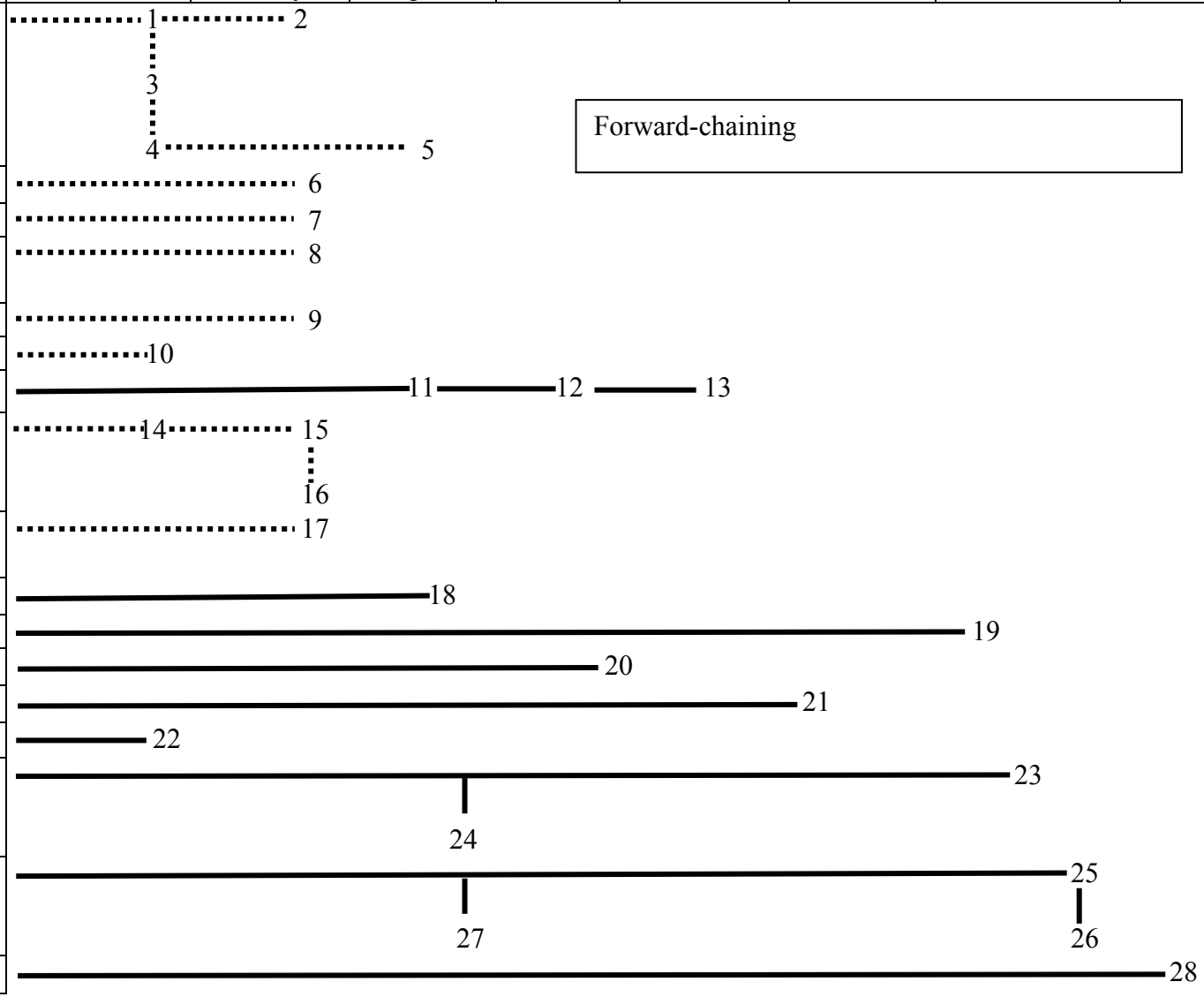
	operator included all inferences except:			studies.[176,194] Higuchi and Donald used the operator "inference" with a similar definition.[170]
• **Match**	Making a connection between current situation and past situations or current patient to past patients.	N/A	. "well it is commonly used [um] if somebody does get a cough from from one of the ACE inhibitors"	This definition came from Hoffman's work.[102] It was also described by Higuchi and Donald.[2] We used the same operator as we found a few segments in our data set that fit with Hoffman's definition.
Review	Name facts, context or objects as well as going over patient data and information provided in the case scenario or profile.	"check the patient profile to see if they are on other medications"	"so, [um] and the fact that he had lab values and lab tests six weeks ago"	The operator "review" was commonly described in clinical reasoning studies as going over patient charts and infromation.[38,102,169,176] We expanded on this definition to include facts and context as pharmacists in our data set seemed to evaluate items by reviewing and listing facts.
Conclude	Make a definitive decision and making a statement about a problem choice.	" so that's how I would check the prescription"	"then Candesartan would be a suitable alternative for it"	This operator was adopted primarily from Fonteyn et al..[36] it was also described by Hoffman as "diagnose" but with a similar definition. As pharmacists did not make a diagnosis

				in this study, we used the operator "conclude" to code segments where they made decisions.
Assume	Making a judgment or a decision based on a hunch.	" I am assuming this is the only medication he has ever taken"	""Well I assumed that you know, the fact that he was using it for his blood pressure"	This operator came primarily from our pilot study.[55] in the thematic analysis we found pharmacists make assumption when they make decisions. We noticed the same pattern in this set of data, and used the operator assume to code it.
Explain	Give reasoning for what they are doing or how things work, as well as rationalizing their choices, actions and decision.	"just to ensure that there is not anything I'd forgot on the main prescription"	"Because I check with him if he has any other medical history"	This operator primarily was adapted from Fonteyn's work.[36] This operator also described in other clinical reasoning studies as "rationale" and "reason". [102,193,194]
Overlooked	Ignoring or disregarding making a judgment. This operator appeared in the retrospective data as pharmacists were promoted with questions. e.g. "Again I didn't really necessarily look	N/A	"well, I did not really decide that actually [laughter]"	This operator emerged from our data set as we noticed that pharmacists in the retrospective think-aloud acknowledged disregarded or overlooked some information when they made their assessments. We did not find a similar operator

	too much into detail at the dosage"			reported in other clinical reasoning studies.
Predict	Expecting or guessing an outcome.	"hopefully it would be working with no side effects"	"It'll be probably a few weeks before they know the blood pressure results"	This operator was adopted from nursing studies by Lamond et al. and Hoffman.[102,193] Similarly, we found pharmacists making predictions for future outcomes.

Appendix 5: Concurrent think-aloud problem behaviour graphs

Pharmacist 101 Concurrent Think-aloud Problem Behaviour Graph									
Concept	Segment	Act	Verify	Explain	Review	Conclude	Infer	Collect	Exit
Prescription	1,2 3 4,5								
Pt name	6								
DOB	7								
Prescriber info	8								
Prescription	9								
Printout	10								
Allergies	11,12, 13								
Printout	14,15 16								
Printout Notes	17								
Medication	18								
Decision	19								
Medication	20								
Decision	21								
EHR	22								
Concomitant Medication	23, 24								
DD interaction	25 26,27								
Decision	28								



Pharmacist 102 Concurrent Think-aloud Problem Behaviour Graph							
Concept	Segment	Act	Review	Explain	Predict	Verify	Conclude
Prescription	29	1					
Medication	30	2					
Quantity	31	3					
Previous Usage	32	4					
Medication	33	5					
Directions	34	6					
Refills	35	7					
Clinical Effect	36	8					
Side Effect	37	9					
PMH	38, 39	10	11				
Allergies	40	12					
Prescription	41	13					
Quantity	42	14					
Printout	43	15					
Prescriber info	44	16					
Medication	45	17					
DIN	46	18					
Directions	47	19					
Refills	48	20					
DD interaction	49	21					

Forward-chaining

Pharmacist 102 Concurrent Think-aloud Problem Behaviour Graph 'continued'							
Concept	Segment	Act	Review	Explain	Predict	Verify	Conclude
Prescription	50	22					
Decision	51						22
Cost	52	23					
	53		24				

Pharmacist 201 Concurrent Think-aloud Problem Behaviour Graph					
Concept	Segment	Act	Explain	Verify	Review
Prescription	54 55, 56 57	1 2	3 4	Forward-chaining	
Pt Name	58	5			
DOB	59	6			
Pt Name	60	7			
Prescriber info	61 62	8 9			
Medication	63	10			
Strength	64	11			
Medication	65	12			
Pt Profile	66	13			
Concomitant Medication	67	14			
Prescription	68	15			
Refills	69	16			
Printout Notes	70 71	17 18			
Vial	72	19			
Labels	73,74	20	21		
Vial	75	22			
Expiry Date	76	23			
DIN	77	24			
Bag	78	25			

Pharmacist 202 Concurrent Think-aloud Problem Behaviour Graph									
Concept	Segment	Verify	Explain	Review	Conclude	Act	Collect	Assume	Exit
Pt Name	79	1							
Printout	80	2							
DOB	81	3							
PHN	82	4							
Prescriber info	83, 84	5	6						
	85	7							
Medication	86	8							
Strength	87	9							
Quantity	88	10							
Directions	89	11							
Refills	90	12							
Prescriber info	91, 92	13	14						
Printout	93	15							
Prescription Date	94	16							
Decision	95	17							
Identification	96	18							
Decision	97, 98	19	20						
EHR	99	21							
Previous Treatment	100	22							
Concomitant Medication	101	23							
	102	24							
Decision	103,104	25							26

Forward-chaining

Pharmacist 301 Concurrent Think-aloud Problem Behaviour Graph							
301	Segment	Verify	Review	Assume	Act	Explain	Conclude
Pt Name	105	1					
Prescription Date	106	2					
DOB	107	3					
Pt Address	108	4					
Prescriber Info	109	5					
Identity	110	6					
Strength	111	7					
Dose	112	8					
Quantity	113	9					
Allergies	114	10					
Identification	115	11					
Quantity	116	12					
Vial	117,118	13	14				
Printout	119	15					
	120		16				
Decision	121,122	17					18

No clinical reasoning

Pharmacist 302 Concurrent Think-aloud Problem Behaviour Graph							
Concept	Segment	Act	Explain	Verify	Review	Conclude	Exit
Prescription	123	1					
Printout	124	2					
Rx Date	125,126	3	4				
	127		5				
	128,129		6	7			
DOB	130	8					
PHN	131	9					
	132		10				
Prescriber info	133	11					
	134,135		12	13			
Medication Identity	136,137	14	15				
Strength	138	16					
Direction	139	17					
Quantity	140	18					
	141		19				
Refills	142	20					
DIN	143,144	21	22				
Expiry Date	145	23					
Decision	146	24					
Medication Identification	147	25					
	148		26				
Allergies	149	27					
	150		28				
Adjudication	151,152	29	30				
Decision	153	31					

Forward-chaining

Pharmacist 401 Concurrent Think-aloud Problem Behaviour Graph							
Concept	Segment	Act	Explain	Verify	Conclude	Review	Exit
Printout	154, 155 158, 156 159, 157 160	1 5 7	2 3 4 6				
Pt Name	161	8					
Pt Address	162	9					
Pt Contact Info	163	10					
Pt DOB	164 165,166	11	12	13			
Pt Gender	167	14					
Prescriber Info	168,169 174,175,170 176,171 172 173	15 21	22 23	16 17 18 19 20			
Medication	177	24					
Medication Identity	178	25					
Strength	179	26					
Directions	180	27					
Quantity	181	28					
Refills	182,183	29		30			
Printout	184	31					

Forward-chaining

Pharmacist 401 Concurrent Think-aloud Problem Behaviour Graph 'continued'							
Concept	Segment	Act	Explain	Verify	Conclude	Review	Exit
Identification	185 186 187		33 34	32			
DIN	188			35			
Identification	189,190 191,192,193 194	40	39	36 38 41	37		
Quantity	195 196,197,198	42	43	41 44			
Expiry Date	199,200	45		46			
Technical Check	201,202	47			48		
Allergies	203 204,205	51	50			49	
Decision	206					52	
Cost	207,208 209	53	55			54	
Decision	210	56					
Labels	211			57			
Bag	212,213 214,215	60	61	58	59		

Pharmacist 401 Concurrent Think-aloud Problem Behaviour Graph 'continued'							
Concept	Segment	Act	Explain	Verify	Conclude	Review	Exit
Labels	216, 217 218,219	62 65	63 64				
Decision	220				66		
Bag	221	67					
Decision	222						68

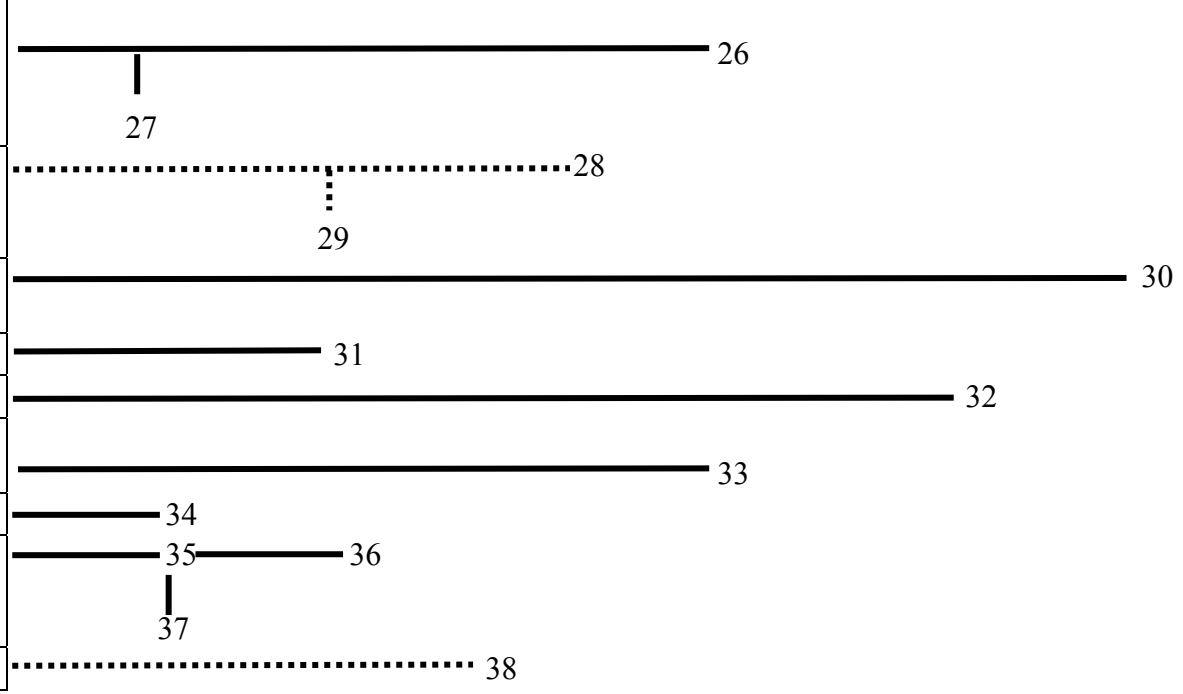
Pharmacist 402 Concurrent Think-aloud Problem Behaviour Graph								
Concept	Segment	Act	Verify	Conclude	Explain	Review	Infer	Exit
Pt name	223 224,225	1 2	3					
Pt Address	226	4						
Patient information	227	5						
Prescriber info	228	6						
Medication Identity	229	7						
Strength	230	8						
Directions	231, 232	9			10			
Quantity	233	11						
Directions	234	12						
Refills	235	13						
Quantity	236	14						
DIN	237	15						
Concomitant Medication	238,239	16			17			
DD Interaction	240	18						
Concomitant Medication	241	19						
Dose	242	20						
Decision	243,244 245	21 23			22			

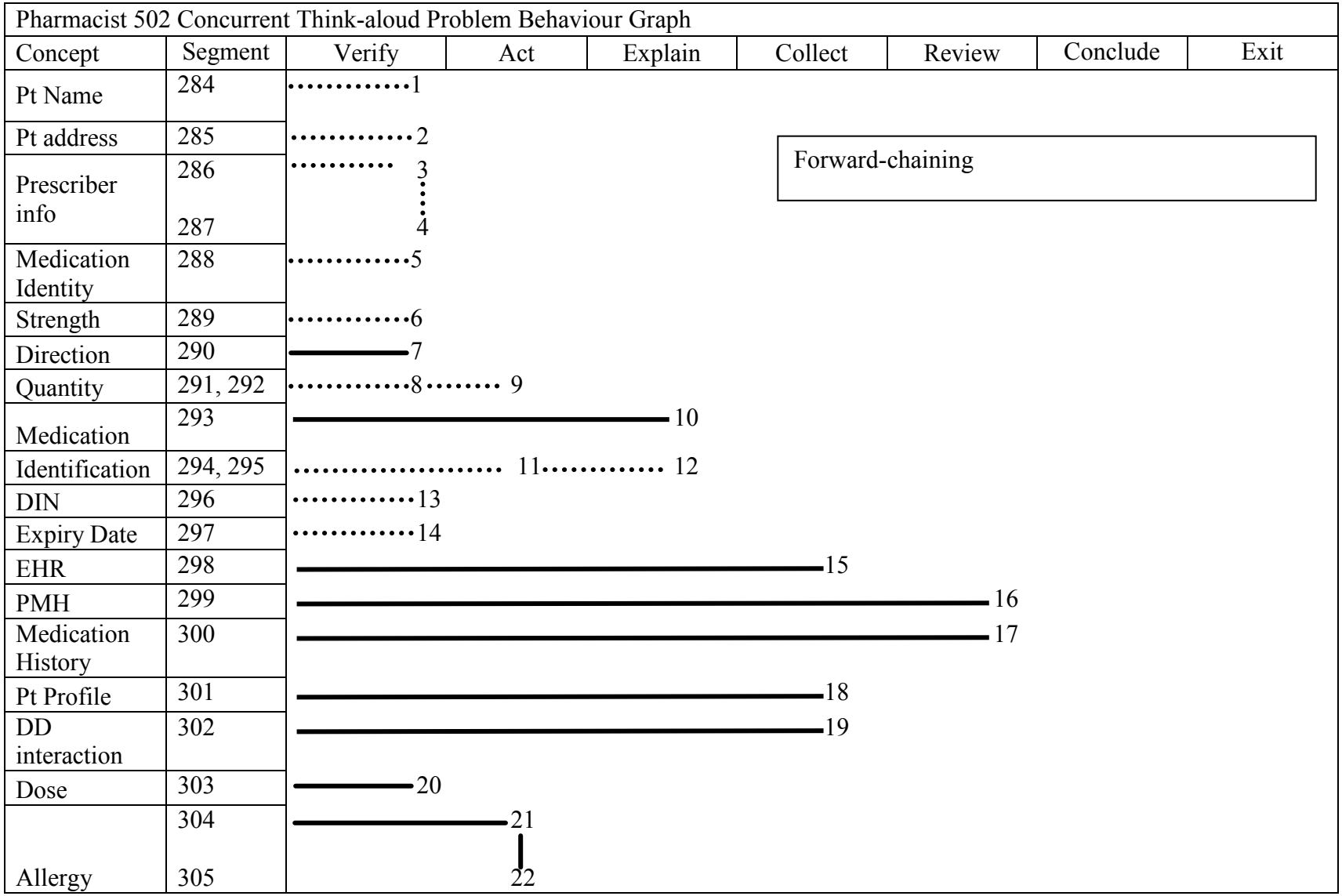
Forward-chaining

Pharmacist 501 Concurrent Think-aloud Problem Behaviour Graph							
Concept	Segment	Act	Explain	Verify	Review	Plan	Collect
Prescription	246	1					
Label	247	2					
Technical Check	248, 249	3	4				
Printout	250	5					
Pt name	251	6					
Pt Address	252	7					
DOB	253	8					
Prescriber Info	254 255, 256 257 258	9	11	10 12 13			
Printout	259,260	14		15			
Quantity	261, 262 263	16	17	18			
Directions	264	19					
DIN	265	20					
Quantity	266	21					
Identification	267 268	22	23				
Cost	269,270	24		25			

Forward-chaining

Pharmacist 501 Concurrent Think-aloud Problem Behaviour Graph							
Concept	Segment	Act	Explain	Verify	Review	Plan	Collect
Allergies	271 272						
Printout notes	273 274						
EHR	275						
DD interaction	276						
Follow up	277						
Previous Treatment	278						
Cough	279						
Follow-up	280,281 282						
Pt Contact info	283						




Pharmacist 502 Concurrent Think-aloud Problem Behaviour Graph
Concept
Segment
Verify
Act
Explain
Collect
Review
Conclude
Exit
Pt Name
284
Pt address
285
Prescriber info
286
287
Medication Identity
288
Strength
289
Direction
290
Quantity
291, 292
Medication
293
Identification
294, 295
DIN
296
Expiry Date
297
EHR
298
PMH
299
Medication History
300
Pt Profile
301
DD interaction
302
Dose
303
Allergy
304
305
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
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21
22
Forward-chaining

Pharmacist 502 Concurrent Think-aloud Problem Behaviour Graph 'continued'								
Concept	Segment	Verify	Act	Explain	Collect	Review	Conclude	Exit
Decision	306,307	23					24	
DOB	308	25						
Prescriber Info	309 310	26 27						
Refills	311	28						
Quantity	312	29						
Decision	313 314,315,316			30 31			32	33

Pharmacist 601 Concurrent Think-aloud Problem Behaviour Graph					
Concept	Segment	Act	Verify	Collect	Explain
Pt Name	317	1			
Pt Address	318	2			
Pt Contact Info	319	3			
DOB	320	4			
Prescription	321	5			
Prescriber Info	322	6			
Medication	323	7			
DIN	324	8			
Quantity	325	9			
PHN	326	10			
Quantity	327	11			
DD interaction	328	12			
EHR	329	13			
Decision	330	14			
Label	331	15			
Vial	332,333	16			17
Identification	334, 335	18	19		
Label	336	20			

Forward-chaining

Pharmacist 602 Concurrent Think-aloud Problem Behaviour Graph				
Concept	Segment	Verify	Act	Explain
Pt Name	337	1		
Pt DOB	338	2		
Prescriber Info	339	3		
Strength	340	4		
DIN	341	5		
Quantity	342	6		
Directions	343	7		
Refills	344	8		
Decision	345	9		
Bag	346	10		
Services	347,348	11		12
	349	13		

No clinical reasoning approach

Pharmacist 603 Concurrent Think-aloud Problem Behaviour Graph							
Concept	Segment	Act	Verify	Conclude	Explain	Collect	Exit
Printout	350	1					
Label	351	2					
Rx Date	352	3					
Pt Name	353	4					
Address	354	5					
DOB	355	6					
Decision	356	7					
Identity	357	8					
Strength	358	9					
Directions	359	10					
Quantity	360	11					
Prescriber Info	361	12					
Printout	362	13					
Identification	363	14					
	364	15					
Medication	365	16					
Identification	366,367	17		18			
Label	368	19					
Printout	369	20					
Cost	370,371	21	22				
Pt Profile	372,373,374	23		24		25	
Concomitant Medication	375	26					
Decision	376,377	27			28		
	378, 379	29					30

Forward-chaining

Pharmacist 701 Concurrent Think-aloud Problem Behaviour Graph								
Concept	Segment	Act	Verify	Explain	Conclude	Collect	Infer	Exit
Printout	380	1						
Medication	381	2						
Prescriber Info	382	3						
Patient Name	383	4						
Printout	384	5						
Prescription	385	6						
Vial	386	7						
Identification	387	8						
Decision	388,389,390	9		10	11			
EHR	391	12						
Decision	392	13						
	393,394,395	16		14	15			
EHR	396	17						
Decision	397	18						
	398,399				19	20		

Forward-chaining

Pharmacist 702 Concurrent Think-aloud Problem Behaviour Graph							
Concept	Segment	Act	Verify	Review	Collect	Explain	Exit
Prescription	400	1					
Patient Name	401	2					
DOB	402	3					
Patient Age	403	4					
Prescriber Info	404	5					
Strength	405	6					
Direction	406	7					
DD interaction	407	8					
EHR	408	9					
Previous Treatment	409	10					
Quantity	410	11					
Decision	411	12					
Cost	412	13					
Decision	413	14					

Forward-chaining

Pharmacist 801 Concurrent Think-aloud Problem Behaviour Graph			
Concept	Segment	Verify	Review
Pt Name	414	1	
DOB	415	2	
Pt Address	416	3	
Pt Gender	417	4	
PMH	418	5	
Prescriber Info	419	6, 7	
Medication Identity	420, 421	8	
Strength	422	9	
Quantity	423	10, 11, 12	
Directions	424, 425, 426	13	
Refills	427	14	
Cost	428	15	

No clinical reasoning approach

Pharmacist 802 Concurrent Think-aloud Problem Behaviour Graph								
Concept	Segment	Act	Verify	Infer	Review	Assume	Explain	Conclude
Prescription	429	1						
Patient Name	430	2						
DOB	431	3						
Prescriber Info	432	4						
Identification	433	5						
DIN	434	6						
Medication Identity	435	7						
Strength	436	8						
Clinical Effect	437	9						
Quantity	438	10						
	439	11						
Directions	440	12						
Medication	441	13						
Pt information	442	14						
Pt Age	443	15						
Previous Usage	444	16						
	445	17						
	446	18						
PMH	447	19						
Previous Usage	448	20						
Dose	449,450	21				22		
Decision	451	23						
	452	24						

Forward-chaining

Abbreviations Pt: Patient; PMH: past medical history; PHN: personal health number; DD: drug-drug; DIN: drug identification number; DOB: date of birth; EHR: electronic health records; Rx: prescription.

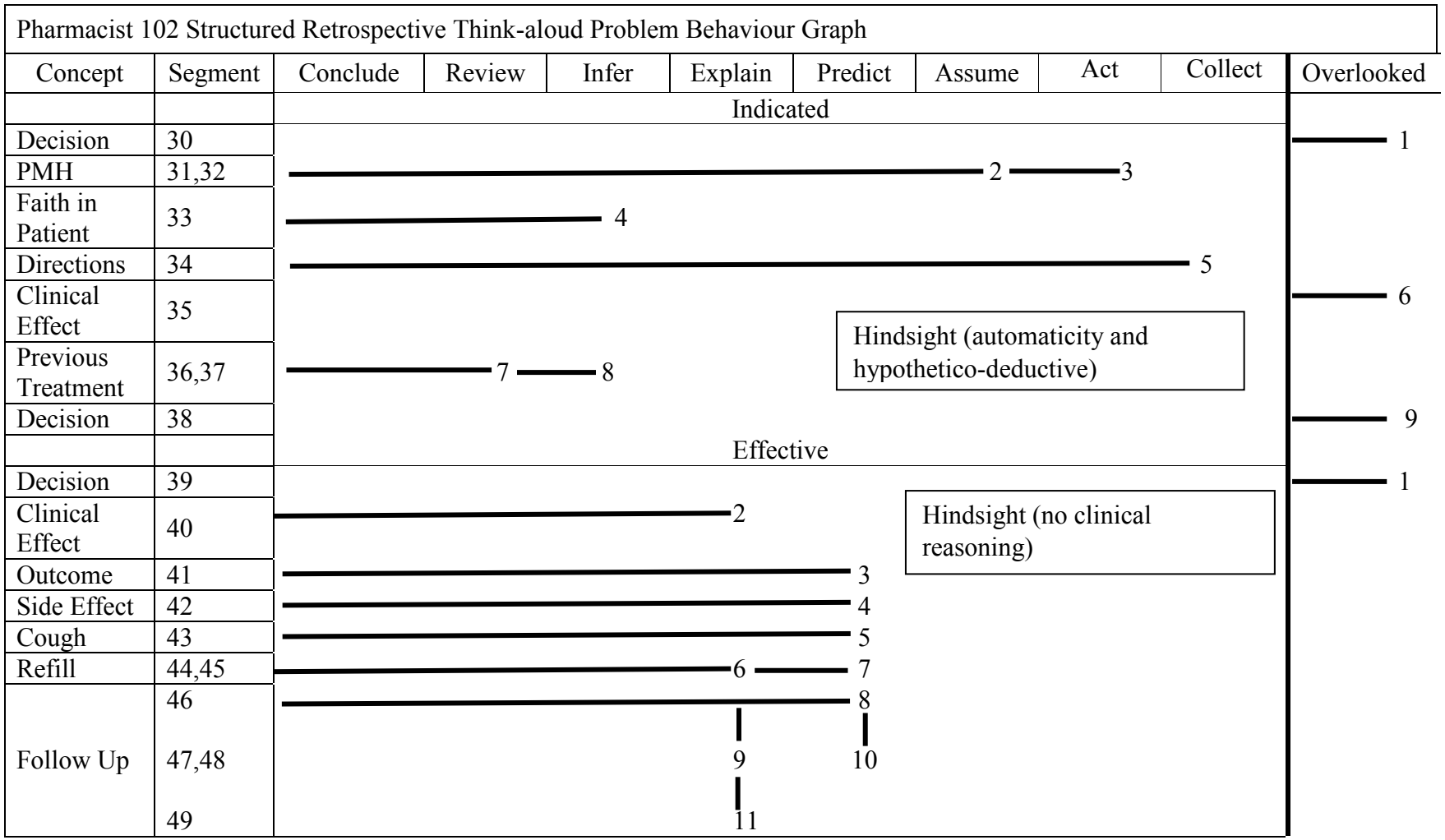
Appendix 6: Retrospective think-aloud problem behaviour graphs

Pharmacist 101 Structured Retrospective Think-aloud Problem Behaviour Graph					
Concept	Segment	Conclude	Explain	Infer	Assume
		Safety			
BP	1	1			
Dose	2	2			
DD interaction	3	4		If/then approach	
Decision	4	4			
DD interaction	5	5			
Decision	6	6			
		Indicated			
Clinical Effect	7	1			
MOA	8	2		Forward-chaining	
Cough	9	3			
		Effective			
Decision	10	1			
Dose	11	2		Hindsight (hypothetico-deductive)	
	12	3			
		Compliance			
Cough	13	1		Forward-chaining	
Pt Concern	14	2			
Patient Goal	15	3			
Decision	16	4			

Pharmacist 102 Structured Retrospective Think-aloud Problem Behaviour Graph

Concept	Segment	Conclude	Review	Infer	Explain	Predict	Assume	Act	Verify	Overlooked
		Safety								
Decision	17									1
Allergies	18		2			3				
	19,20				4					
Decision	21	5								
Physician Assessment	22		6							
BP Reading	23		7							
Previous Treatment	24, 25,26		8				10			9
Comparative	27						11			
Side Effect	28, 29		12				13			

Hindsight with forward chaining


Pharmacist 102 Structured Retrospective Think-aloud Problem Behaviour Graph
Concept
Segment
Conclude
Review
Infer
Explain
Predict
Assume
Act
Collect
Overlooked
Indicated
Decision 30
PMH 31,32
Faith in Patient 33
Directions 34
Clinical Effect 35
Previous Treatment 36,37
Decision 38
Hindsight (automaticity and hypothetico-deductive)
Effective
Decision 39
Clinical Effect 40
Outcome 41
Side Effect 42
Cough 43
Refill 44,45
Follow Up 46
47,48
49
Hindsight (no clinical reasoning)
1
2
3
4
5
6
7
8
9
10
11

Pharmacist 102 Structured Retrospective Think-aloud Problem Behaviour Graph

Concept	Segment	Conclude	Review	Infer	Explain	Predict	Assume	Act	Verify	Overlooked
		Compliance								
Faith in Patient	50									1
Previous Treatment	51	2						Hindsight (automaticity)		
Decision	52	3								
	53	4								

Pharmacist 201 Structured Retrospective Think-aloud Problem Behaviour Graph										
Concept	Segment	Conclude	Review	Verify	Infer	Match	Act	Explain	Plan	Overlooked
		Safety								
EHR	54	1								
Clinical Effect	55	2								
		Intuition								
		Indicated								
Clinical Effect	56	1								
		Automaticity								
		Effective								
Decision	57	1								
	58	2								
		Hindsight (pattern recognition)								
		Compliance								
Decision	59, 60	2								1
Follow up Call	61,62	3							4	
	63	5								Hindsight (no clinical reasoning)
Cough	64	6								
Follow up	65	7								

Pharmacist 202 Structured Retrospective Think-aloud Problem Behaviour Graph

Concept	Segment	Conclude	Infer	Review	Collect	Predict	Explain	Assume	Overlooked
		Safety							
HTN	66	1							
Medication History	67	2							
Decision	68	3							
Allergies	69, 70	4							5
Side Effect	71								6
Clinical Effect	72	7							
		Indicated							
HTN	73	1							
		Effective							
Previous Treatment	74	1							
	75		2						
Clinical Effect	76	3							
Decision	77	4							
		Compliance							
Pt Concern	78	1							
Side Effect	79	2							
	80					3			
Decision	81	4							

Forward-chaining

Forward-chaining

Forward-chaining

If/then

Pharmacist 301 Structured Retrospective Think-aloud Problem Behaviour Graph								
Concept	Segment	Conclude	Explain	Review	Infer	Assume	Act	Plan
		Safety						
Clinical Effect	82	1						
Medication	83	2						
	84	3						
Cough	85	4						
Decision	86	5						
		Indicated						
Decision	87	1						
Previous Treatment	88	2						
Decision	89	3						
Clinical Effect	90	4						
	91	5						

Forward-chaining

Hypothetico-deductive

Pharmacist 301 Structured Retrospective Think-aloud Problem Behaviour Graph 'continued'								
Concept	Segment	Conclude	Explain	Review	Infer	Assume	Act	Plan
		Effective						
Comparative	92	1						
Cough	93	2				Forward-chaining		
Decision	94	3						
MOA	95	4						
Decision	96,97	5	6					
		Compliance						
Previous Treatment	98	1						
Directions	99	2				Forward-chaining		
Dose	100	3						
Alternative Therapy	101	4						
Follow Up	102	5						
	103	6						

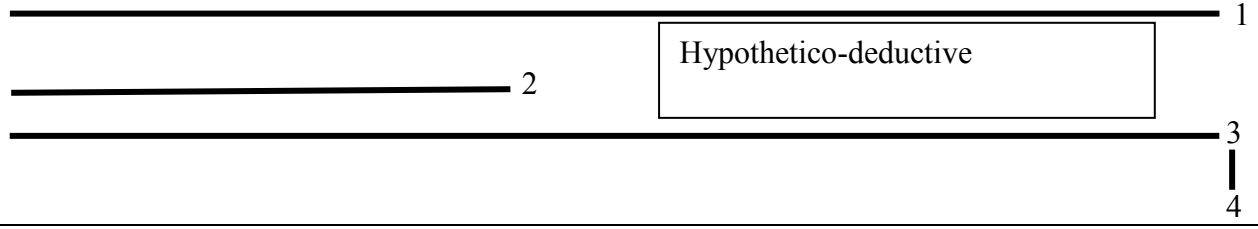
Pharmacist 302 Structured Retrospective Think-aloud Problem Behaviour Graph							
Concept	Segment	Conclude	Infer	Review	Assume	Explain	Act
		Safety					
Comparative	104	1					
PMH	105 106	2 3					
Dose	107	4					
Decision	108	5					
		Indicated					
Clinical Effect	109	1					
Previous Treatment	110 111	2 3					
Decision	112	4					
Side Effect	113	5					
		Effective					
Alternative Therapy	114,115,116	1				2 3	
Decision	117	4					

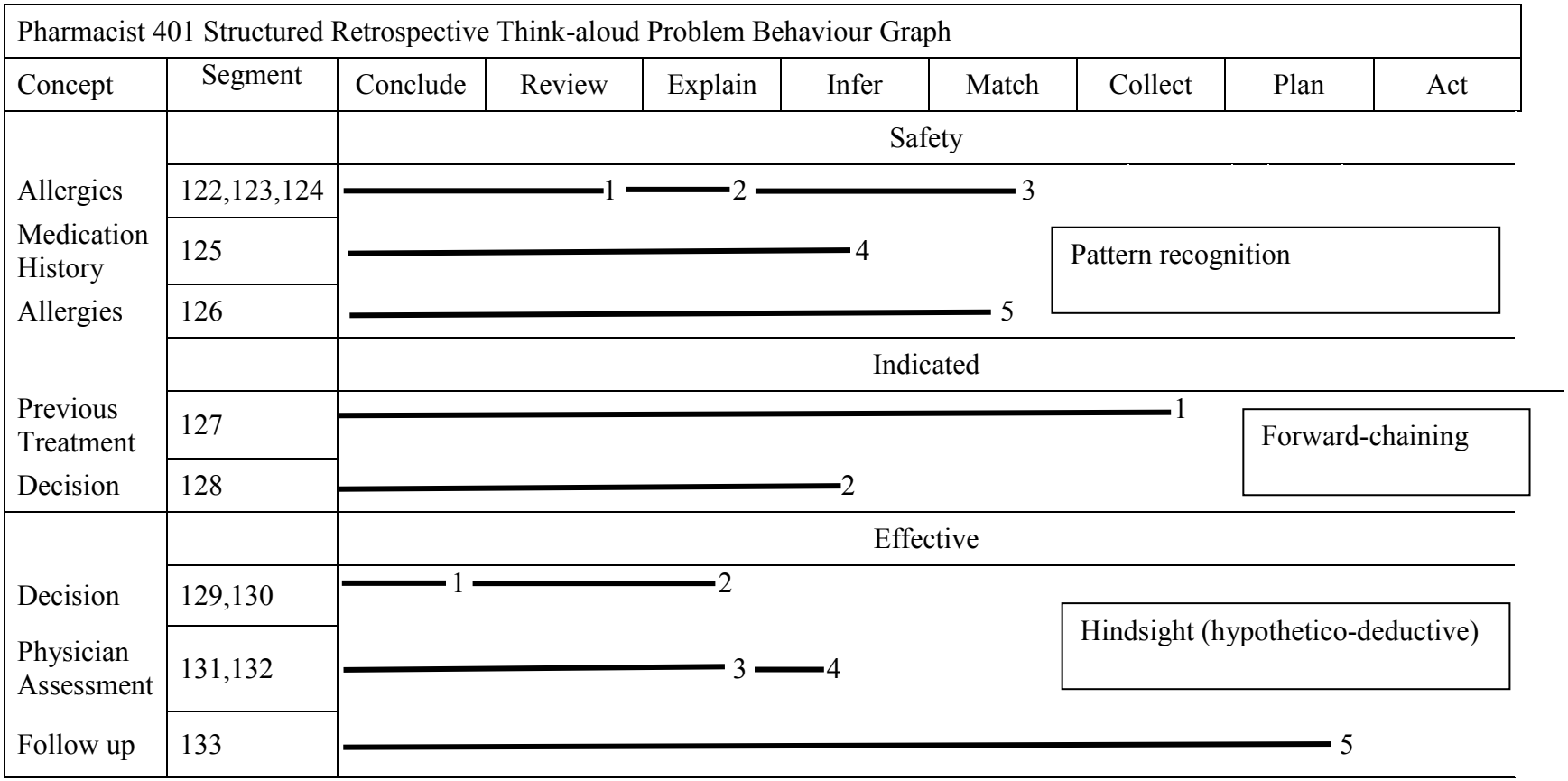
Forward-chaining

Hindsight (automaticity and hypothetico-deductive)

If/then

Pharmacist 302 Structured Retrospective Think-aloud Problem Behaviour Graph 'continued'							
Concept	Segment	Conclude	Infer	Review	Assume	Explain	Act
		Compliance					
Assertion	118						
Cough	119						
Assertion	120						
	121						




Pharmacist 401 Structured Retrospective Think-aloud Problem Behaviour Graph
Concept
Segment
Conclude
Review
Explain
Infer
Match
Collect
Plan
Act
Safety
Allergies
122,123,124
1
2
3
Medication History
125
4
Pattern recognition
Allergies
126
5
Indicated
Previous Treatment
127
1
Forward-chaining
Decision
128
2
Effective
Decision
129,130
1
2
Physician Assessment
131,132
Hindsight (hypothetico-deductive)
3
4
Follow up
133
5

Pharmacist 401 Structured Retrospective Think-aloud Problem Behaviour Graph 'continued'

Concept	Segment	Conclude	Review	Explain	Infer	Match	Collect	Plan	Act
		Compliance							
Evident	134	1							
Concomitant Medication	135	2							
Decision	136	3							
Dose	137,138			4		5			
	139			6					
	140			7					
Assertion	141								8
Directions	142								9
Daily Routine	143								10
	144			11					
Directions	145		12						

If/then and forward-chaining

Pharmacist 402 Structured Retrospective Think-Aloud Problem Behaviour Graph											
Concept	Segment	Review	Infer	Explain	Conclude	Predict	Match	Act	Collect	Plan	Overlooked
		Safety									
Dose	146,147	1 — 2									
Decision	148	3									
DD Interaction	149	4									
Concomitant Medication	150	5									
Dose	151	6									
DD Interaction	152	7									
PMH	153	8									
Decision	154	9									
		Indicated									
Clinical Effect	155	1									
Cough	156	2									
Alternative Therapy	157	3									
Decision	158	4									
		Effective									
Decision	159	1									
BP	160	2									
Previous Treatment	161–162	3, 4									
Alternative Therapy	163	5									
Outcome	164	6									
BP Reading	165–166	7, 8									

Pattern recognition and forward-chaining

Forward-chaining

Hypothetico-deductive

Pharmacist 402 Structured Retrospective Think-Aloud Problem Behaviour Graph											
		Review	Infer	Explain	Conclude	Predict	Match	Act	Collect	Plan	Overlooked
		Compliance									
Decision	167	1									
Follow up	168										2
Clinical Effect	169	3									
Follow Up	170,171	4									5
Outcome	172	6									
Daily Routine	173	7									
	174,175	8		9							

Forward-chaining

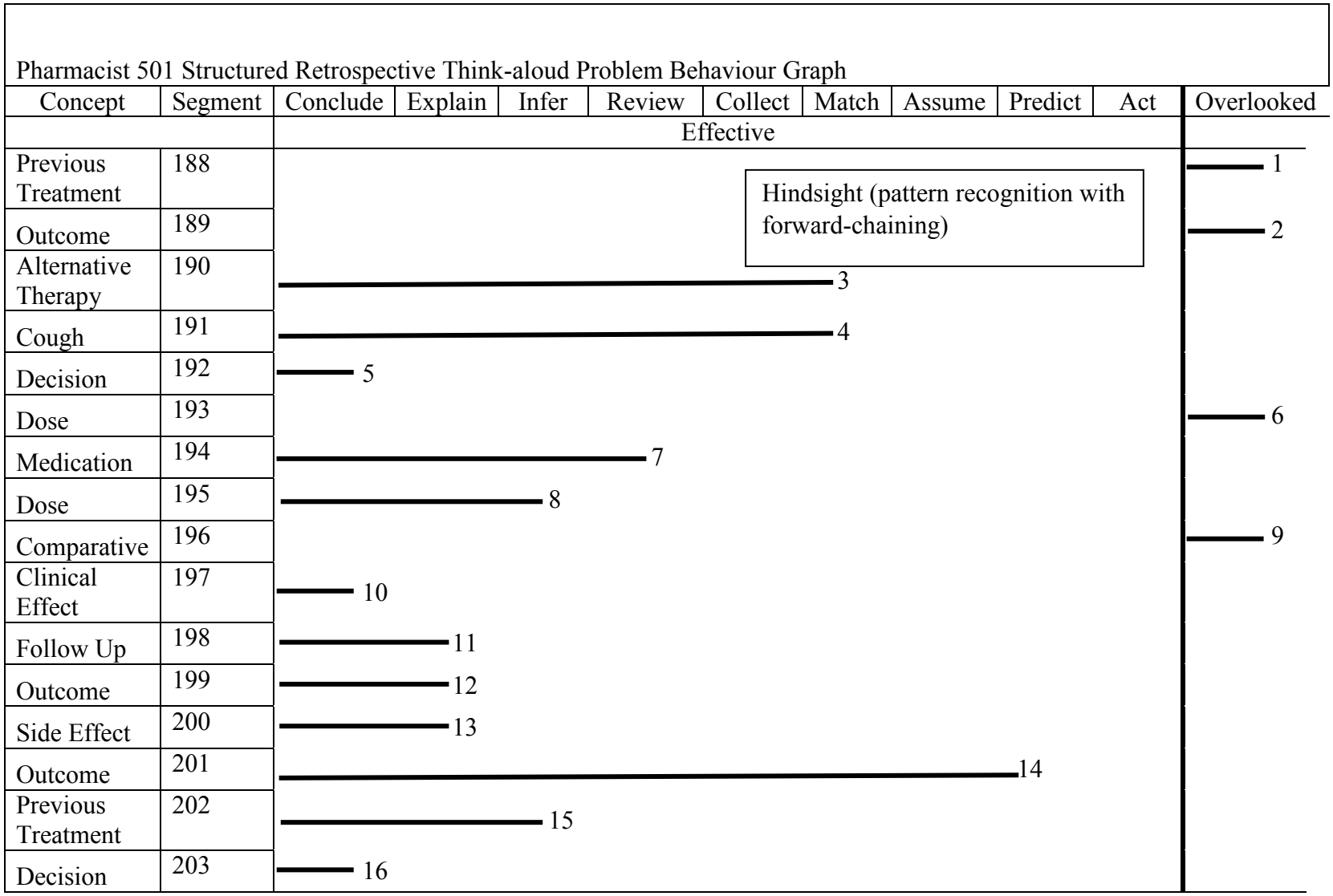
Pharmacist 501 Structured Retrospective Think-aloud Problem Behaviour Graph

Concept	Segment	Conclude	Explain	Infer	Review	Collect	Match	Assume	Predict	Act	Overlooked
		Safety									
Medication History	176	1									
Patient Age	177	2									
Allergies	178	3									
Dose	179	4									
Medication History	180	5									
		Indicated									
PMH	181	1									
Previous Usage	182	2									
Medication History	183	3									
Physician Assessment	184	4									
Cough	185	5									
Decision	186	6									
Physician Assessment	187	7									

Hypothetico-deductive

Hypothetico-deductive

Pharmacist 501 Structured Retrospective Think-aloud Problem Behaviour Graph



Pharmacist 501 Structured Retrospective Think-aloud Problem Behaviour Graph

Concept	Segment	Conclude	Explain	Infer	Review	Collect	Match	Assume	Predict	Act	Overlooked
		Compliance									
Decision	204										1
Follow Up	205									2	
Faith in Patient	206,207			3						4	
Follow Up	208									5	
Refill	209									6	
Follow Up	210			7							
Directions	211			8							
Physician Assessment	212			9							
Decision	213			10							

Hindsight (no clinical reasoning)

Pharmacist 502 Structured Retrospective Think-aloud Problem Behaviour Graph						
Concept	Segment	Review	Explain	Conclude	Infer	Collect
		Safety				
Previous Treatment	214	1			Forward-chaining	
Comparative	215	2				
Clinical Effect	216	3				
Dose	217	4				
Decision	218	5				
		Indicated				
Clinical Effect	219	1			Forward-chaining	
Past Medical History	220	2				
Decision	221	3				
		Effective				
Comparative	222	1			Forward-chaining	
Cough	223	2				
Decision	224,225	3		4		
		Compliance				
Directions	226	1			Forward-chaining	
Daily Routine	227	2				
Previous Treatment	228,229	3		4		
Decision	230	5				

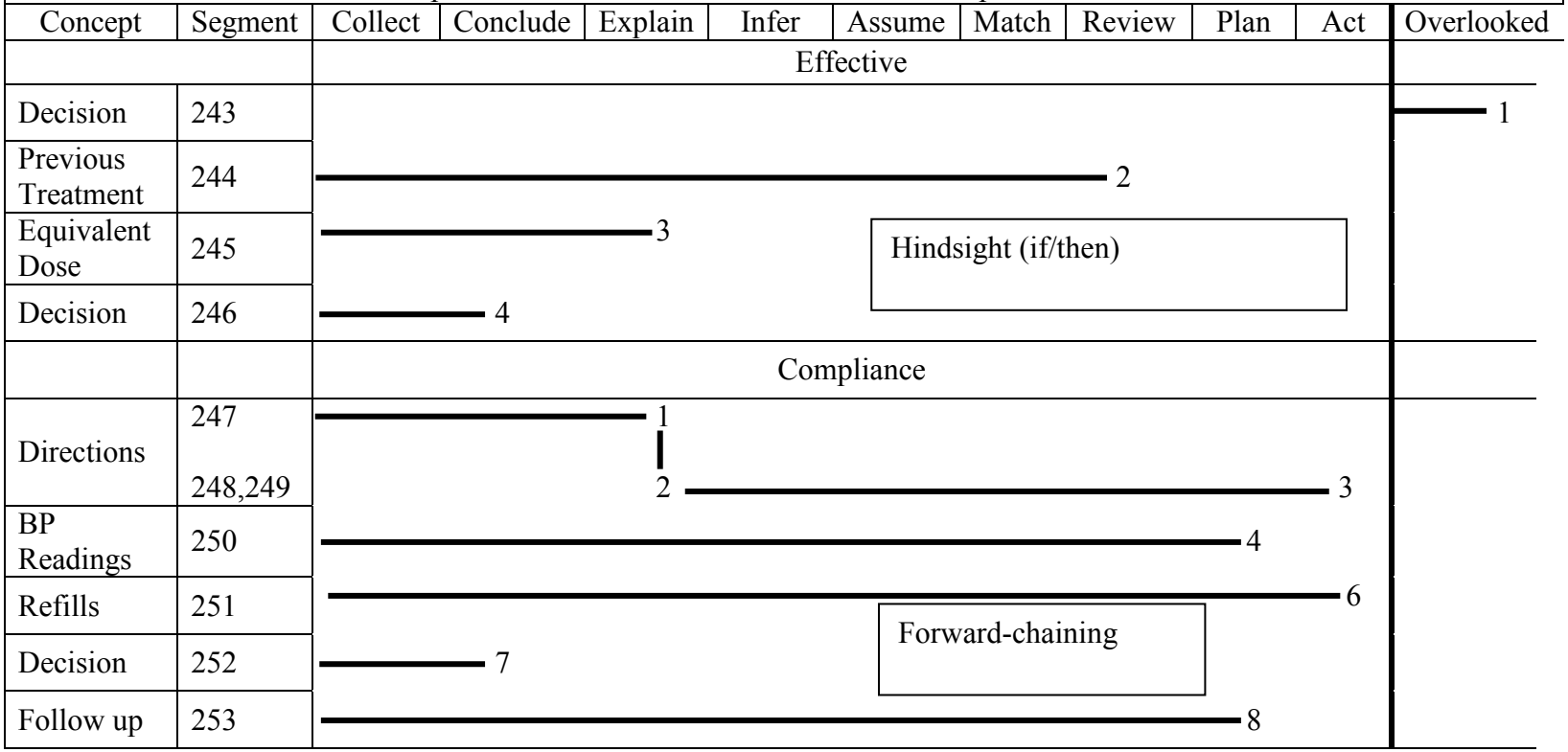
Pharmacist 601 Structured Retrospective Think-aloud Problem Behaviour Graph

Concept	Segment	Collect	Conclude	Explain	Infer	Assume	Match	Review	Plan	Act	Overlooked
		Safety									
Evident	231	1									
Quantity	232	2									
MOA	233	3									
Drug Info Resources	234	4									
Equivalent Dose	235	5									
Drug Info Resources	236	6									
Decision	237, 238	8									7
Drug Info Resources	239	9									
		Indicated									
Clinical Effect	240	1									
Previous Treatment	241	2									
Decision	242	3									

Hypothetico-deductive

Dual process (pattern recognition and forward-chaining)

Pharmacist 601 Structured Retrospective Think-aloud Problem Behaviour Graph



Pharmacist 602 Structured Retrospective Think-aloud Problem Behaviour Graph									
Concept	Segment	Conclude	Match	Review	Infer	Assume	Collect	Explain	Plan
		Safety							
Dose	254	1							
Medication History	255	2							
Comparative	256	3							
Clinical Effect	257	4							
Decision	258	5							
		Indication							
Clinical Effect	259	1							
		Effective							
Previous Treatment	260	1							
Decision	261	2							
	262	3							
		Compliance							
Follow up	263	1							
Previous Adherence	264	2							
Comparative	265	3							

Dual process (pattern recognition and forward-chaining)

Forward-chaining

Hindsight (forward-chaining)

Forward-chaining

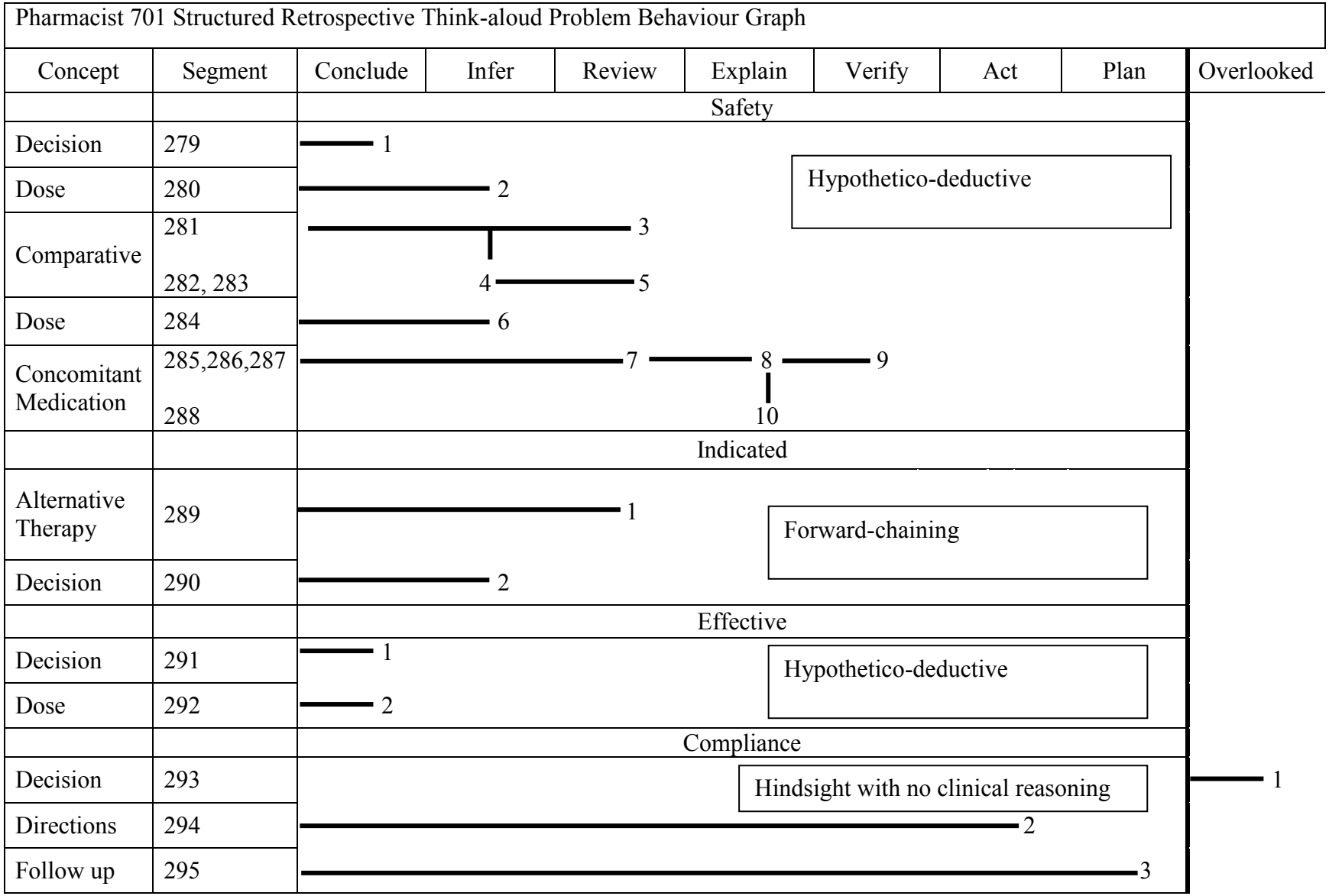
Pharmacist 603 Structured Retrospective Think-aloud Problem Behaviour Graph									
Concept	Segment	Conclude	Explain	Review	Match	Infer	Collect	Plan	Assume
		Safety							
Allergies	266	1							
Decision	267	2							
Alternative Therapy	268	3							
Comparative	269	4							
		Indicated							
Clinical Effect	270	1							
		Effective							
BP Reading	271 272,273	1 3 2							
Clinical Effect	274	4							
		Compliance							
Evident	275	1							
Cough	276	2							
Evident	277	3							
Decision	278	4							

Dual process (pattern recognition and forward-chaining)

Forward-chaining

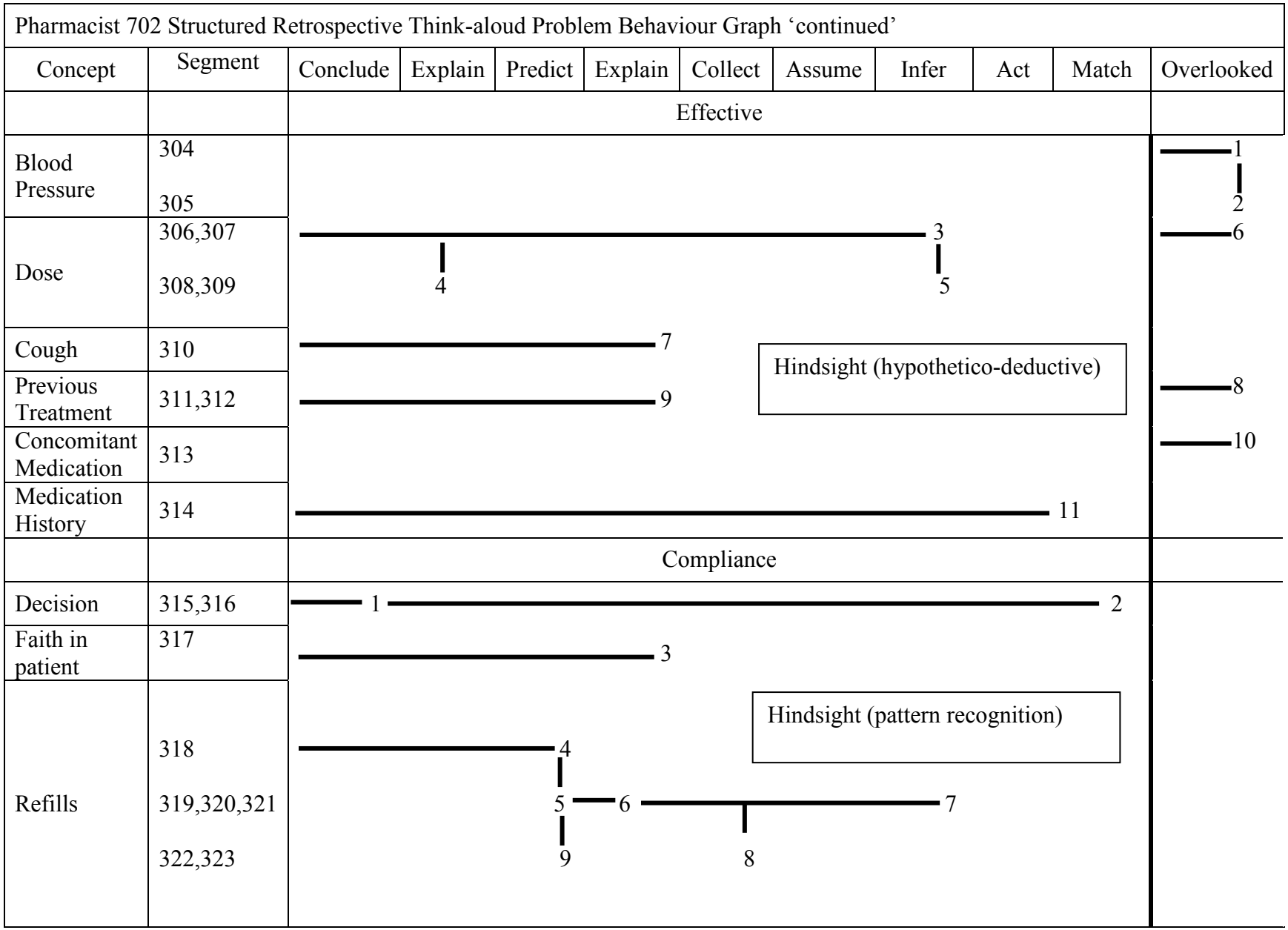
Hindsight with no clinical reasoning

Forward-chaining


Pharmacist 701 Structured Retrospective Think-aloud Problem Behaviour Graph
Concept
Segment
Conclude
Infer
Review
Explain
Verify
Act
Plan
Overlooked
Safety
Decision
279
Dose
280
Comparative
281
282, 283
Dose
284
Concomitant Medication
285,286,287
288
Hypothetico-deductive
Indicated
Alternative Therapy
289
Decision
290
Forward-chaining
Effective
Decision
291
Dose
292
Hypothetico-deductive
Compliance
Decision
293
Directions
294
Follow up
295
Hindsight with no clinical reasoning

Pharmacist 702 Structured Retrospective Think-aloud Problem Behaviour Graph											
Concept	Segment	Conclude	Explain	Review	Explain	Collect	Assume	Infer	Act	Match	Overlooked
		Safety									
Previous Usage	296	1						Forward-chaining			
Medication History	297 298,299	2 3				4					
Allergies	300	5									
DD Interaction	301	6									
		Indicated									
Faith in Pt	302	1							Intuition		
Decision	303	2									

Pharmacist 702 Structured Retrospective Think-aloud Problem Behaviour Graph 'continued'



Pharmacist 801 Structured Retrospective Think-aloud Problem Behaviour Graph							
Concept	Segment	Conclude	Explain	Infer	Review	Plan	Assume
		Safety					
PMH	324	1					
Medication History	325	2					
DD Interaction	326	3					
	327	4					
Decision	328	5					
		Indicated					
HTN	329	1					
Medication History	330	2					
	331	3					
Cough	332	4					
Decision	333	5					
		Effective					
BP Reading	334	1					
Follow Up	335	2					
Clinical Effect	336,337	3		4			
Side Effect	338	5					
Decision	339	6					
		Compliance					
Evident	340	1					
Previous Treatment	341	2					
Patient Competency	342	3					
	343	4					
Decision	344	5					

Hindsight (forward-chaining)

Forward-chaining

Hindsight (forward-chaining)

Hindsight (hypothetico-deductive)

Pharmacist 802 Structured Retrospective Think-aloud Problem Behaviour Graph						
Concept	Segment	Conclude	Infer	Match	Review	Explain
		Safety				
Dose	345	1				
Decision	346	2				
DD Interaction	347			3		
Concomitant Medication	348			4		
		Indicated				
HTN	349	1				
Medication History	350			2		
Cough	351				3	
Decision	352	4				
		Effective				
Dose	353	1				
Previous Treatment	354			2		
Comparative	355			3		
Dose	356		4			
		Complaiance				
Alternative Therapy	357,358	1				2
Daily Routine	359		3			

Hypothetico-deductive

Hindsight (forward-chaining)

Hindsight (hypothetico-deductive)

Hypothetico-deductive

Abbreviations

Pt: Patient; PMH: past medical history; MOA: mode of action; DD: drug-drug; BP: Blood pressure; DOB: date of birth; EHR: electronic health records; Rx: prescription; HTN; hypertension.

Appendix 7: Frequency of operators and their corresponding concepts in concurrent think-aloud

Concept	Operator	Frequency
Allergies	Act	4
	Conclude	1
	Explain	3
	Review	5
	Verify	1
Bag	Act	5
	Explain	2
Clinical Effect	Infer	1
	Predict	1
Concomitant Medication	Act	1
	Collect	3
	Explain	3
	Review	2
Cost	Act	4
	Explain	2
	Review	3
	Verify	4
Cough	Act	1
Drug-Drug Interaction	Collect	1
	Explain	2
	Infer	3
	Review	1
	Verify	2
Decision	Act	11
	Conclude	17

	Exit	10
	Explain	7
	Infer	2
Drug Identification Number	Act	1
	Explain	1
	Verify	9
Directions	Explain	2
	Review	2
	Verify	11
Date of Birth	Explain	1
	Verify	15
Dose	Explain	1
	Infer	2
	Verify	2
Electronic Health Record	Act	1
	Collect	7
Expiry Date	Act	3
	Verify	2
Follow-up	Act	2
	Explain	1
	Plan	1
Gender	Verify	2
Identification	Act	8
	Explain	9
	Verify	8
Label	Act	6
	Explain	2
	Verify	4

Medication	Act	2
	Explain	3
	Review	5
	Verify	4
Medication History	Review	1
Medication Identity	Act	1
	Verify	8
Patient Address	Verify	8
Patient Age	Review	1
	Verify	1
Patient Contact Info	Verify	3
Patient Information	Act	1
	Conclude	1
Patient Name	Act	3
	Explain	1
	Verify	14
Patient Profile	Act	2
	Collect	2
	Explain	1
Personal Health Number	Explain	1
	Verify	3
Past Medical History	Act	1
	Explain	1
	Review	2
	Verify	1
Prescriber Info	Act	2
	Explain	6
	Verify	32

Prescription	Act	14
	Explain	3
	Verify	3
Prescription Date	Act	1
	Explain	3
	Verify	4
Previous Treatment	Explain	1
	Review	2
Previous Usage	Assume	1
	Explain	1
	Review	3
Printout	Act	13
	Conclude	2
	Explain	5
	Review	1
	Verify	5
Printout Notes	Explain	2
	Verify	3
Quantity	Act	5
	Explain	3
	Review	1
	Verify	22
Refills	Act	2
	Verify	9
Services	Act	1
	Explain	1
	Verify	1
Side Effect	Predict	1

Strength	Act	1
	Verify	11
Technical Check	Act	2
	Conclude	1
	Explain	1
Vial	Act	3
	Explain	1
	Review	1
	Verify	2

Appendix 8: Frequency of operators and their corresponding concepts in retrospective think-aloud

Pharmacotherapy Element	Concept	Operator	Frequency of Operator
Indicated	Alternative Therapy	Infer	1
		Review	1
	Clinical Effect	Act	1
		Assume	1
		Collect	1
		Explain	2
		Infer	2
		Match	1
		Overlooked	1
		Review	2
	Cough	Explain	3
		Review	1
	Decision	Assume	1
		Conclude	6
		Infer	5
		Overlooked	2
	Directions	Collect	1
	Faith in Patient	Explain	1
		Infer	1
	Hypertension	Collect	2
		Infer	1
		Review	1
	Medication History	Infer	1
		Review	2
	Mode of Action	Infer	1
	Physician Assessment	Review	2
	Past Medical History	Assume	1
		Collect	1
		Explain	1
	Previous Treatment	Collect	2
		Infer	3
		Review	4
	Previous Usage	Review	1
	Side Effect	Explain	1
Effective	Alternative Therapy	Explain	3

		Match	1
		Review	1
	Blood Pressure	Overlooked	2
		Review	1
	Blood Pressure Reading	Act	1
		Collect	1
		Explain	2
		Plan	2
	Clinical Effect	Conclude	1
		Explain	2
		Infer	1
		Plan	1
		Review	1
	Comparative	Infer	1
		Overlooked	1
		Review	2
	Concomitant Medication	Overlooked	1
	Cough	Explain	2
		Infer	1
		Match	1
		Predict	1
	Decision	Conclude	12
		Explain	3
		Infer	3
		Match	1
		Overlooked	2
		Predict	1
	Dose	Conclude	1
		Explain	2
		Infer	6
		Overlooked	2
	Equivalent Dose	Explain	1
	Follow-up	Explain	4
		Plan	1
		Predict	2
	Medication	Review	1
	Medication History	Act	1
	Mode of Action	Explain	1
	Outcome	Explain	1

		Overlooked	1
		Predict	3
	Physician Assessment	Explain	1
		Infer	1
	Previous Treatment	Explain	3
		Infer	3
		Overlooked	2
		Review	3
	Refill	Explain	1
		Predict	1
	Side Effect	Explain	1
		Predict	1
		Review	1
Safety	Age	Review	1
	Allergies	Assume	1
		Explain	2
		Match	1
		Overlooked	1
		Predict	1
		Review	5
	Alternative Therapy	Match	1
	Blood Pressure	Explain	1
	Blood Pressure Reading	Review	1
	Clinical Effect	Conclude	1
		Infer	2
		Review	1
		Verify	1
	Comparative	Explain	1
		Infer	4
		Predict	1
		Review	2
	Concomitant Medication	Explain	2
		Review	3
		Verify	1
	Cough	Infer	1
	Drug-Drug Interaction	Explain	2
		Review	6
	Decision	Conclude	13
		Infer	1

		Overlooked	2
	Drug Information Resources	Collect	1
		Explain	2
	Dose	Conclude	2
		Infer	8
		Match	2
	Electronic Health Record	Review	1
	Equivalent Dose	Infer	1
	Evident	Explain	1
	Hypertension	Review	1
	Medication	Conclude	2
	Medication History	Collect	2
		Explain	1
		Review	6
	Mode of Action	Infer	1
	Physician Assessment	Infer	1
		Review	1
	Past Medical History	Explain	1
		Infer	1
		Review	2
	Previous Treatment	Assume	1
		Overlooked	1
		Review	2
	Previous Usage	Explain	1
	Quantity	Explain	1
	Side Effect	Overlooked	1
		Predict	1
		Review	1
Compliance	Alternative Therapy	Conclude	1
		Explain	1
		Infer	1
	Assertion	Act	4
	Blood Pressure Reading	Plan	1
	Clinical Effect	Explain	1
	Comparative	Infer	1
	Concomitant Medication	Review	1
	Cough	Explain	2
		Infer	1
		Review	1

	Daily Routine	Act	1
		Collect	1
		Explain	2
		Infer	2
		Review	1
	Decision	Act	1
		Assume	2
		Conclude	7
		Explain	1
		Infer	2
		Match	1
		Overlooked	3
		Review	1
	Directions	Act	3
		Explain	3
		Review	2
	Dose	Explain	3
		Infer	1
		Review	1
	Evident	Assume	1
		Review	3
	Faith in Patient	Explain	2
		Overlooked	1
		Predict	1
	Follow-up	Act	3
		Explain	2
		Infer	1
		Overlooked	2
		Plan	7
	Outcome	Explain	1
	Patient Competency	Explain	1
		Infer	1
	Patient Interest	Assume	1
		Infer	1
		Predict	1
	Physician Assessment	Explain	1
	Previous Adherence	Infer	1
	Previous Treatment	Act	1
		Assume	1

		Collect	1
		Infer	1
		Review	1
	Refill	Act	2
		Collect	1
		Explain	1
		Infer	1
		Predict	3
	Side Effect	Explain	1
		Predict	1