

DEVELOPMENT OF A KNOWLEDGE EXCHANGE AND UTILIZATION MODEL FOR
EMERGENCY PRACTICE

by

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*This work is dedicated to my son, Shawn Scott Smith,
and my mother, Margaret Curran*

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Abstract

Knowledge is a critical element for the provision of quality health care. Optimal clinical decision making incorporates multiple types of knowledge including patient knowledge, clinical experiential knowledge and research knowledge. Understanding how knowledge is shared and used in best practice is challenging as a number of factors can facilitate or impede the process. Several authors have highlighted the value of using a theoretical framework when examining knowledge in health care. A theoretical framework provides direction for the generation and testing of hypotheses which can contribute to building a comprehensive body of knowledge in a field of study. Although the majority of knowledge exchanged in practice settings occurs between clinicians, current knowledge exchange and utilization models in health care generally focus specifically on the exchange of research knowledge between the scientific community and the practice community. Acknowledging and understanding the knowledge seeking and sharing behaviours of clinicians is a key element in the larger knowledge translation puzzle.

Emergency medicine is a clinical speciality where there is evidence of a knowledge to practice gap, however, there is limited understanding of the factors that contribute to the gap. Emergency practitioners must make decisions in a busy and often chaotic environment that is prone to multiple interruptions and distractions. The challenge for consistent and quality care is also more pronounced in rural and some suburban areas where emergency care needs are similar but resources are limited. The purpose of this program of research is to identify factors relevant to knowledge exchange and utilization in rural and urban emergency departments with the aim of developing a **Model for Knowledge Exchange and Utilization in Emergency Practice**. A series of studies were carried out using a mixed method research design to further develop and describe 3 key dimensions (individual, context of practice, knowledge) which were identified through a review of the literature. Data was collected using surveys, participant observations and interviews with nurses and physicians working in rural and urban emergency departments in Nova Scotia. Triangulation of results across the studies contributed to developing a comprehensive and rigorous description of the 3 dimensions of interest.

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Chapter 1: Introduction

Background to the Problem

Knowledge is a critical element for the provision of quality health care. Optimal clinical decision making incorporates multiple types of knowledge such as patient knowledge, clinical experiential knowledge and research knowledge (Haynes, 2002). How knowledge is accessed and applied in practice is of great interest and concern to patients, clinicians, researchers, administrators, and funding agencies. The way that clinicians become aware of new knowledge and decide to incorporate knowledge into their practice is complex. Access to knowledge can be limited by factors such as busy work schedules, inadequate library resources, insufficient staff skills mix or an individual clinician's inability to interpret or understand the knowledge as it is presented. However, even when practitioners are presented with a synthesis of best practice knowledge in the form of clinical practice guidelines they often fail to change their practice behaviour. Studies suggest that 30-40% of patients do not receive care complying with current research evidence and 20-25% of the care provided is not needed or potentially harmful (Eccles & Grimshaw, 2004). These findings highlight the need to better understand how knowledge is shared and used in clinical practice and provide the impetus for this program of research.

Understanding how knowledge is shared and used in best practice is challenging as a number of factors can facilitate or impede the process. Several authors have highlighted the value of using a theoretical framework when examining knowledge in health care practice (Eccles, Grimshaw, Walker, Johnson, & Pitts, 2005; Abraham & Michie, 2008; Godin, Belanger-Gravel, Eccles, Grimshaw, 2008). A theoretical framework provides direction for the generation and testing of hypotheses which can contribute to building a comprehensive body of knowledge in this emerging field. A theoretical perspective can also improve the design and evaluation of evidence based interventions versus atheoretically derived interventions that are based on trial and error or tradition. Meaningful outcomes are limited when interventions lack an organizing framework or theoretical basis.

Knowledge exchange is of interest both within and outside of health care. In the information sciences and organization learning literature, knowledge exchange is viewed from a broad perspective where knowledge is a valuable resource to be shared among all members of the communities, teams, and organizations that work together (Lehmann & Lehner, 2005). In health care, however, the concept is generally considered through a narrower lens. Theories and models related to knowledge exchange in the health care literature have primarily focused on exchange of scientific knowledge between the scientific community and the end users (e.g. clinicians, policy makers). This approach is limited as scientific knowledge is but one of the many types of knowledge exchanged and used in clinical practice. Current models for knowledge exchange in health care overlook the prevalence and importance of social relationships among clinicians for acquiring knowledge. Health care practitioners cite speaking with respected peers or colleagues as a primary source of practice knowledge (Estabrooks, Chong, Brigidear, & Profetto-McGrath, 2005; Bennett, Casebeer, Zheng, & Kristofco, 2006; Davies, 2007). This suggests that important knowledge exchange occurs not only between the scientific and practice community but also between practitioners who are members of the same community. Knowledge flows through multiple networks in a practice setting and it is important to understand how these networks operate in order to ensure different types of knowledge are blended together to inform best practice. A more inclusive model for knowledge exchange in practice is necessary to account for the multiple ways in which practitioners seek and share knowledge.

The community of practice literature provides a perspective which may be useful to view knowledge exchange in clinical practice. “Community of practice” refers to a group that emerges around a common problem or clinical population to develop best practice knowledge by engaging in the sharing of resources and collective learning (Wenger, 1998). Examples of community of practice models in health care include a virtual community of practice to support the adoption of pediatric data standards (Miles, Miller, Payne, Perelman, Saffer & Zimmerman, 2009) and a community of practice to support emergency clinicians in the implementation of best practice research (Huckson & Davies, 2007). This literature and other models relevant to knowledge exchange will be explored in more detail in chapter 3.

Similar to knowledge exchange, knowledge utilization also crosses a number of disciplines and scientific fields within and outside of health care. However, models of knowledge utilization are further developed and more plentiful in the health care literature than knowledge exchange models. Knowledge utilization is usually described as an action process whereby knowledge is either applied in a policy or used in clinical decision making. As with knowledge exchange, most models are concerned about the relationship between the research community and the practice community. This relationship is usually described in a hierarchical fashion with either the scientific or the practice community taking precedence. Determinants of knowledge utilization have been found to be multi-faceted, involving individual and organizational factors (Estabrooks, Wallin, & Milner, 2003). Unfortunately, most models fail to specify the relationships among the many factors that influence knowledge utilization or offer any clear direction for development of intervention strategies. In addition the majority of knowledge utilization models or theories are broad in scope and provide limited guidance for understanding utilization in complex clinical settings such as emergency departments (EDs). A detailed review of the models related to knowledge utilization will also be presented in chapter 3.

Emergency medicine is a clinical speciality where there is evidence of the knowledge to practice gap but limited understanding of the factors which contribute to the gap. Under utilization of thrombolytics in women and the elderly who present to the ED when it has been well established through clinical trials that early administration of thrombolytic therapy is important for reducing mortality in acute myocardial infarction illustrates the gap between “knowing” and “doing” in emergency care (European Secondary Prevention Study Group, 1996; Kaplan, Fitzpatrick, Cox, Shamma, & Marder, 2002). A similar pattern of under utilization of best practice knowledge has been found related to the use of tissue plasminogen activator (t-PA) for acute stroke management (Hills & Johnston, 2006), with additional disparity found between rural patients and their urban counterparts (Leira, Hess, Torner & Adams, 2008). Other examples where variation exists in the use of best practice knowledge in emergency practice settings include the treatment of migraine headaches (Hurtado, Vinson & Vandenberg, 2007; Richer, Graham, Klassen & Rowe, 2007), bronchiolitis (Plint, Johnson, Wiebe, Bulloch, Pusic, Joubert et al.,

2004), asthma (Stanley, Teach, Mann, Alpern, Gerardi, Mahajan et al, 2007), pain management (Ducharme, 2005; Heins, Heins, Grammas, Costerllo, Huang & Mishra, 2006) and the management of fever in young children (Isaacman, Kaminer, Veligeti, Jones, Davis, & Mason, 2001). Clinical practice guidelines (CPGs) incorporate the best available evidence into a standard set of directions to assist clinicians to provide appropriate care for specific conditions (Institute of Medicine (IOM), 1992). Although the number of available CPGs in EDs has grown in recent years, variation in health provider use of best practice knowledge continues to exist both within and between emergency practice settings. These examples of the knowledge to practice gap in the ED highlight an urgent need to explore facilitators and barriers to the exchange and use of best practice knowledge in this specialty area.

EDs pose unique challenges for the exchange and use of best practice knowledge. The mission of emergency medicine is to provide rapid diagnosis and treatment to a range of medical emergencies. Emergency practitioners must make decisions in a busy and often chaotic environment that is prone to multiple interruptions and distractions. In one time-motion task-analysis study where ED physicians were observed over a 180 minute time interval, physicians saw a mean of 12 new patients (range 5 – 20), performed a mean of 67 tasks, were interrupted a mean of 31 times and were required to change tasks a mean of 20 times (Chisholm, Collison, Nelson & Cordell, 2000). In addition, ED clinicians do not have the benefit of multiple patient visits to formulate a diagnosis and treatment plan. Consequently, ready access to best practice knowledge is critical to support optimal decision making. The volume of patients in an ED at any one time can also contribute to the chaos of the ED environment. Although peak patient flow patterns have been identified, patient census and presentation in the ED can be unpredictable as the majority of visits (approx. 95%) are unscheduled. In 2003-2004 3.3 million Canadians (one in eight individuals) over the age of 15 were treated in an ED with over 80% of patients being discharged home after treatment (Canadian Institute for Health Information (CIHI), 2005). Canadians are more active users of EDs when compared with people in the US, Australia or New Zealand (CIHI, 2005). This high volume use in Canada is an issue for both urban and rural Canadian EDs and can have a negative impact on physician productivity and patient outcomes (Drummond, 2002; Bond, Ospina, Blitz, Afilalo, Campbell, Bullard et al., 2007).

These practice environment characteristics which are distinctive to EDs, create unique challenges when addressing the space between knowledge and best practice.

Emergency care for children presents an additional layer of complexity contributing to the knowledge to practice gap in the ED. In 2000 there were approximately 400,000 visits to pediatric emergency departments in Canada, which represents an annual rate of 534 visits per 10,000 children (Canadian Association of Emergency Physicians (CAEP), 2001). However, this number is only a small fraction of the total number of children who seek emergency care. The majority of pediatric emergencies are actually seen and cared for in general EDs (CIHI, 2008) with children less than five years of age accounting for the highest number of pediatric visits (CIHI, 2005). Caring for children who present to a general ED with acute illness or injury requires additional time, special pediatric equipment and pediatric education resources, each of which has been found to be in short supply in general EDs (McGillivray, Nijssen-Jordan, Kramer, Yang, & Platt, 2001). While one study has reported that care provided in pediatric EDs is based on evidence (Waters, Wiebe, Cramer, Hartling & Klassen, 2006), others studies report variation in practice in the emergency care of children in both specialized pediatric EDs and general or mixed population EDs (Plint et al 2004; Richer et al 2007; Stanley et al 2007). Attention to the knowledge to practice gaps that exist in the emergency care for children who present to the ED is critical to ensure consistent quality care.

The challenge for consistent and quality care is also more pronounced in rural and some suburban areas where emergency care needs are similar but resources are limited. Half of all emergency care in Canada is delivered in rural or suburban EDs (CAEP, 2001). Yet in many rural EDs there are fewer accessible inpatient beds, insufficient staff complement, few if any practitioners with pediatric or emergency expertise, limited access to sub specialists in medicine, surgery, trauma, or mental health and inadequate continuing education opportunities (Wadman, Muelleman, Hall, Tran & Walker, 2005; Bhimani, Dickie, McLeod, & Kim, 2007; Van Vonderren, 2008). In addition, access to information and library services are often inadequate (Dorsch, 2000; Andrews, 2005) These conditions not only create challenges for managing patient flow in the ED but also for developing and maintaining a level of provider expertise to deliver optimal care. Scarcity of resources has also been shown

to contribute to emergency physician job dissatisfaction (Rondeau & Francescutti, 2005). Attention to job satisfaction is of particular concern considering the shortage of family physicians willing or able to staff community EDs (CAEP, 2001). Nursing in rural EDs also demands an expanded role of practice and a need for a wide range of knowledge and skills in situations where support and resources are minimal (MacLeod, Kulig, Stewart, Pitblado, Banks, D'Arcy, et al., 2004). The resource disparity between rural and urban EDs is of concern when one considers that a critical mass of expertise leads to better patient outcomes (Smith, 2002) and rural Canadians have poorer outcomes from acute medical illness (CAEP, 2001). Injuries are a common reason for seeking care in EDs however; the rate of injury-related ED visits is higher in rural and remote areas (Macpherson & Schull, 2006). The lack of medical expertise in rural EDs contributes to a two-fold increase in mortality rate for the same traumatic injuries in rural centers versus urban centers in Canada (CAEP, 2001). Understanding the unique barriers and facilitators for the exchange and use of best practice knowledge in rural and suburban EDs is necessary to advance quality emergency care in these settings.

Clinicians in EDs face numerous challenges in the provision of quality care. Studies exploring practice variation in emergency practice settings have identified organizational factors such as type of EDs, number of patient visits, previous department practice patterns, and individual factors such as the providers' training and experience as potential factors contributing to the variation in practice (Heins et al, 2006; Hurtado et al 2007; Richer et al 2007). Care in the ED often depends on the collaborative efforts of a multidisciplinary team and the use of the best available knowledge to address the presenting problem. The existence of social (work-related) relationships among ED practitioners and/or other specialty practitioners creates opportunities for the discussion of challenging cases and the sharing of expert knowledge. However, the nature of the ED practice setting (unpredictable patient volume, acuity and presentation) poses a challenge for sustained and meaningful shared interactions. Limited staff numbers in smaller, rural EDs further decrease opportunities for knowledge exchange. Collaborative technologies such as electronic discussion boards may enhance opportunities for the growth of strong social networks and may facilitate knowledge sharing among time-challenged and geographically dispersed rural and urban practitioners (Curran & Abidi, 2007; Curran, Murphy,

Abidi, Sinclair & McGrath, 2009). However, little is known about the preferred sources of knowledge of rural and urban emergency clinicians, the knowledge seeking and sharing behaviours related to these knowledge sources or the factors associated with knowledge exchange and utilization in emergency practice settings. One observational study examining the clinical questioning behaviour of physicians from two moderate-volume EDs in the United States identified the most commonly used information sources of ED physicians as a paper or computerized drug reference, colleagues and various electronic resources such as Google or UpToDate (Graber, Randles, Ely, & Monnahan, 2008). Time and distraction by other ED events were identified as barriers to pursuing answers to questions (Graber et al., 2008). Improving efficiency and effectiveness in knowledge-intensive environments such as emergency practice settings requires attending to the ways that clinicians seek out knowledge and learn from and solve problems that arise in practice. To date there is a paucity of literature or research examining knowledge exchange and utilization in emergency practice settings.

Project Objectives

Before we can develop interventions to enhance the exchange and use of knowledge in rural and urban emergency practice settings we must first understand the factors that influence or underlie knowledge exchange and utilization behaviour in these settings. This program of research seeks to identify factors relevant to knowledge exchange and utilization in rural and urban EDs with the aim of developing a **Model for Knowledge Exchange and Utilization in Emergency Practice**. The following research questions were examined and contributed to developing and refining the model:

1. How do emergency clinicians from rural and urban emergency practice settings respond to an opportunity to participate in an online discussion forum for knowledge seeking and sharing?
2. What are the typical knowledge sources used by practitioners in solving clinical problems of patients who present in emergency departments?
3. What are the typical knowledge seeking and knowledge sharing behaviours of rural and urban emergency clinicians?

4. What are the perceived barriers and facilitators to knowledge exchange and utilization?

Methods

This program of research involved two phases. First a review of relevant literature was carried out to identify factors which act as barriers or facilitators to knowledge exchange and utilization in an ED setting. Then, a series of 3 studies were conducted to better understand how knowledge is shared and used in rural and urban practice settings by multidisciplinary health professionals and further develop and describe the factors identified through the review of the literature. A mixed method research design is an effective strategy when addressing such complex questions. Different methods can offer different insights of equal importance. Therefore the 3 studies were conducted using quantitative and qualitative methods to explore the ways in which knowledge is sought, shared and used by emergency clinicians in rural and urban Nova Scotia. Data was collected through surveys, participant observations and interviews. Triangulation of results across studies contributed to developing a comprehensive and rigorous description of the major barriers and facilitators.

Outcomes

To date knowledge exchange and utilization research in emergency medicine is very limited. This program of research has lead to a better understanding of the barriers and facilitators that contribute to knowledge exchange and utilization in rural and urban emergency practice settings.

Specific tangible outcomes include:

1. A description of the knowledge seeking and sharing behaviours of emergency clinicians in rural and urban settings.
2. A description of the types of knowledge used in rural and urban ED settings
3. A better understanding of how social networks are used for knowledge exchange among rural and urban emergency clinicians and implications for communication technologies to enhance network development.

4. Development of a Model for Knowledge Exchange and Utilization in Emergency Practice which describes barriers and facilitators for sharing different types of knowledge.

Conclusion

The process for moving best practice knowledge to the point of patient care is not well understood. While it is generally accepted that there is no magic bullet to enhance the use of knowledge in practice, understanding and attending to the barriers and facilitators will likely lead to the development of successful intervention strategies. Emergency practice environments pose unique challenges for the exchange of best practice knowledge as is evidenced by the current variation in care provided both within and between emergency departments. The lack of available research exploring the unique barriers and facilitators for knowledge exchange and utilization in rural and urban emergency practice settings presents as a gap in the emergency practice literature. This program of research will provide the necessary groundwork for beginning to understand this important phenomenon.

Chapter 2: Knowledge and Practice

Introduction

Throughout history knowledge has been a highly valued element of health care. Although the ancient Greeks believed that knowledge and faith were synonymous (Rich, 1979), the current positivist stance of western medicine can be traced back to the late 18th century when scientific concepts of disease began to replace metaphysical explanations of illness (Cockerham, 2004). During the 19th century there was an emphasis on describing physiological processes and bacteriological research in an effort to legitimize the practice of medicine. The post World War II era in Canada saw a rising interest in biomedical research leading to the establishment of a federal funding agency in 1960, the Medical Research Council, to support medical research (Medical Research Council of Canada (MRCC), 2000). Initial investments were focused in basic science to further understand the determinants and pathophysiology of disease but also to support the heavy emphasis in medical education on the basic sciences. However, the need to test new innovations in clinical practice settings would eventually lead to an allocation of funds to applied research. Applied research methods were initially primarily observational; however research methods pioneers such as Archie Cochrane in the UK and David Sackett in Canada would legitimize the use of experimentation in clinical settings that would lead to the use of randomized control trials becoming the hallmark of testing (Haynes, 2002). Today, randomized control trials continue to be the gold standard and other than meta-analysis, are cited more often in the research literature than any other study design (Patsopoulos, Analatos, & Ioannidis, 2005).

Ideally knowledge and practice in health care should function interdependently, each influencing the evolution or development of the other. However, the current knowledge to practice gap, which is well described in the health services literature (Davis, Evans, Jadad, Perrier, Rath, Ryan et al., 2003) would suggest that knowledge development has outpaced practice development. Examination of the relationship between knowledge and practice is an important first step in understanding how and why knowledge is exchanged and used in practice. Therefore this chapter will provide an overview of the types and sources of knowledge used in clinical practice and

present some of the challenges to the establishment of an evidence based practice environment.

Types of Knowledge

Knowledge is central to professional practice (Leicht & Fennell, 2001). However, before we can explore knowledge as a critical resource in health care it is important to define the concept and distinguish between terms that are commonly associated with knowledge, namely information and evidence. Information is a collection of facts that become knowledge only when it has relevance and is placed in context (Sanders & Heller, 2006). Knowledge is regarded as a higher structure of information that is ready to be applied in decisions or actions (Davenport, De Long, & Beers, 1998). The term evidence, which is often used interchangeably with the term knowledge, has created some confusion in the health care literature particularly for those interested in measuring knowledge or evidence utilization in practice (Scott-Findlay & Pollock, 2004). The definition of evidence as colloquial or scientific will vary depending on the particular stakeholder group perspective (Lomas, 2005). It has been suggested that evidence is one of the most fashionable words in health care today (Roycroft-Malone, Sears, Titchen, Harvey, Kitson, & McCormack, 2004) and its connection with best practice through terms such as evidence-based medicine and evidence-based nursing are visible in the literature across multiple disciplines and specialties. While the term evidence is often linked with scientific evidence, a broader conceptualization would see evidence as inclusive of multiple types of knowledge that has been subjected to testing and found to be credible (Higgs & Jones, 2000). A clear definition of knowledge is critical for understanding barriers and facilitators for knowledge exchange and utilization.

Knowledge is present in healthcare in both explicit and tacit formats. Explicit knowledge is codified knowledge represented by information in textbooks, journals or clinical practice guidelines (CPG) (Mansingh, Osei-Bryson, & Reichgelt, 2009). Explicit knowledge is the type of formal knowledge that is shared through curriculum in medical schools, published in journals or the principles and facts found in text books or guidelines and used by practitioners to guide patient diagnosis and treatment (Patel, Arocha, & Kaufman, 1999). Tacit health care knowledge, on the other hand, is

the non-formalized knowledge that guides expert practice (Cheah, Rashid, & Abidi, 2002). Tacit knowledge is gained through clinical experience and involves the coupling of medical facts with a gestalt of managing a patient (Patel et al., 1999). Tacit knowledge can be a challenge to explicate but development and sharing is facilitated by reflection in practice. In dealing with the health and disease of individuals from a variety of sociocultural environments, health disciplines need a broad scope and base of knowledge (Malterud, 2001). Five kinds of knowledge, which include both tacit and explicit formats, are important to guide practice and clinical decision making (Tonelli, 2006). These include pathophysiologic rationale, empirical evidence, experiential or clinical knowledge, knowledge about patient values and preferences, and knowledge of organizational or system features such as resource availability or legal concerns. Each type of knowledge has unique characteristics which may influence exchange and utilization and therefore, will be explored separately in the remainder of this section.

Basic pathophysiologic science is germane to the majority of health disciplines. The background for understanding physiological processes is generally derived through bench research (Youngblut & Brooten, 2001) and clinicians spend the majority of their formative training years in “an oppressively thick undergrowth of facts” about pathophysiologic processes (Horton, 1995). In clinical practice the contribution of basic science knowledge to clinical decision making is often unrecognized and devalued. In practice the biomedical knowledge becomes encapsulated under clinical fact such that the practicing clinician may not consciously identify the basic science principles employed in their practice decisions (Rikers, Schmidt, & Moulaert, 2005). Understanding the underlying mechanism of disease can enhance diagnostic reasoning therefore it is important for experienced practitioners to assist novice clinicians to explicitly see these connections during their clinical training (Woods, 2007).

Empirical evidence is knowledge that is explicit, systematic, and replicable (Lomas, 2005). It is understood to be knowledge derived from scientific (qualitative and quantitative) enquiry, with academic institutions such as universities and academic health centres being the leading producers of this type of knowledge (Bartunek, Trullen, Bonet, & Sauquet, 2003). Knowledge derived from scientific inquiry is

generally made available to practitioners through a number of formats including presentation at academic/clinical specialty conferences or publication in a scholarly journal. The first published randomized control trial (RCT) appeared in the *British Medical Journal* in 1948 (Haynes, 2004). Over the past decade qualitative or interpretive modes of inquiry have also added to the volume of evidence in the health care research literature (Rice & Ezzy, 1999). Today the volume of explicit knowledge is increasing rapidly with more than 10,000 new randomized trials added to Medline each year (Grol & Grimshaw, 2003). Estimates are that there are greater than 2,000,000 biomedical publications every year and as the volume of empirical evidence grows, so does the challenge with staying abreast of current scientific knowledge.

Clinical practice or experiential knowledge evolves from interaction with patients. It has been conceptualized in a number of different ways but is most commonly understood to be tacit in nature. It is a valuable resource given that 40% to 90% of needed knowledge in organizations is tacit in nature (Handzic, 2000). However, tacit knowledge is generally denied scientific legitimacy because it is not available for inquiry through biomedical approaches (Malterud, 2006). Expert practitioners carry with them an abundance of tacit knowledge arising from years of clinical practice experience with specific populations such as children who present in emergency departments. In clinical practice tacit knowledge is an important part of diagnostic reasoning and judgment (Malterud, 1995). Tacit knowledge represents a rich resource for novice or inexperienced practitioners and is typically shared as an expert practitioner mentors a novice in the practice setting. However, tacit knowledge is a challenge to explicate for wider use because it arises in the context of practice and is not systematically available in traditional explicit sources.

Good clinical practice involves knowing the patient not just the disease. Patients' previous experiences with care, their knowledge about their bodies and their social situation are important types of knowledge to be incorporated into patient centred care (Rycroft-Malone, Seers, Titchen, Harvey, Kitson, & McCormack, 2004). Each individual patient brings a unique body of knowledge to the clinician-patient interaction which can impact the patients' response to treatment. The integration of patient experiences and preferences with other types of knowledge is essential for the

provision of evidence based practice (Greenhalgh, 1999; Grypdonck, 2006). Bringing this type of knowledge to the point of care can be challenging and it has been suggested that the medical gaze is often privileged as a source of knowledge over the patients' voice (Malterud, Candib, & Code, 2004). However, the adoption of patient-centred and family centred models of care can create opportunities for individual patient knowledge to be included in decisions about care.

Organizational and system knowledge exists in numerous formats. It can be found in the electronic health records of patients, audit and performance feedback documents, as well as clinical outcome and program evaluation records. It exists at a number of levels including specific care units within a health centre, the health care organization as a whole or at the government health systems level. Sharing organizational or system knowledge has the potential to streamline health care resources, reduce practice variation, and prevent ineffective practice. Organizational knowledge has been recognized as a valuable asset in the information and organizational management literature. However, this type of knowledge has not truly been recognized as a legitimate aspect of evidence-based health care and thus its potential has not been fully explored (Rycroft-Malone et al., 2004).

Blending Different Types of Knowledge

Understanding how different types of knowledge can be blended together to inform best practice is of concern to many scholars interested in knowledge exchange and utilization research (Titchen & McGinley, 2004; Greenhalgh, Robert, MacFarlane, Bate, & Kyriakidou, 2004). While scholars agree that blending different types of knowledge is important for best practice, there is limited understanding in the health services literature about how this process occurs. The field of cognitive science may provide some useful insight for understanding how physicians use different types of knowledge in practice (Patel, Arocha, & Kaufman, 2001). Clinicians are unable to fully appreciate how to cope with illness solely through the acquisition of massive amounts of factual knowledge. These limitations in their information-processing abilities require them to rely on heuristics when making clinical decisions (Patel, Kaufman & Arocha, 2002). This view of action in clinical practice emphasizes the importance of experiential or clinical knowledge. Practitioners learn from their

practice as they incorporate both tacit and explicit types of knowledge into their actions and clinical decisions. This is a continuous process which occurs at an unconscious level and contributes to excellent performance (Bartunek, Trullen, Bonet, & Sauquet, 2003). Parallel dual processing models of reasoning suggest that there are actually two cognitive modes of information processing that are in constant operation at the same time (Sladek, 2006). One mode is experiential, fast and relies on heuristics while the other mode of reasoning is more deliberate, rational and rule based. In medical decision making both of these modes work in parallel, each balancing and checking the other, however, it is the rational mode which provides opportunities for the introduction of new explicit knowledge (Sladek, 2006).

In the field of nursing, an “expert practitioner” is also characterized by the use of different types of explicit and tacit knowledge (Benner, 1982), however the manner in which these different types of knowledge are blended is unclear. Fawcett and Garity (2009) propose two approaches for combining practice and research knowledge. The first is a single-case research approach in which nurses come to view each encounter with a patient as both a research and practice experience. The second approach involves routinely gathering audits of information from the practice setting for the purpose of exploration and discussion. While both approaches are possible strategies they require significant motivation and resource allocation on the part of the individual clinician and the health care organization.

Lomas (2005) describes a deliberative process for combining multiple types of evidence or knowledge and suggests that a context specific evaluation of each type of knowledge is required prior to inclusion. The process is particularly attractive when uncertainty exists or a clinical issue is debatable and it promotes dialogue and consensus in decision making (Lomas, 2005). However, it is unclear how this process would bear out in acute, rapidly changing emergency scenarios. The blending of different types of knowledge is known to occur in practice settings and appears to be important in the development of best practice, however, there is limited understanding in the health care literature regarding the specific mechanism by which this blending occurs.

The current hierarchical structure of health care knowledge and the preference for scientific knowledge over other types of knowledge may be a limiting factor in finding a clear process for blending knowledge from different sources. A variety of grading systems or organizing structures can be found which categorize the different types of health care knowledge and rank them according to their strength and freedom from bias. Although the number of levels in the various structures may differ, the trend is generally consistent. Systematic reviews of a homogenous set of randomized control trials are ranked as the best source of evidence while expert opinion or opinions based on clinical experience, bench research or descriptive studies are considered to be the lowest level of evidence (Oxford Centre for Evidence-based Medicine Levels of Evidence, 2001). A review of the citation impact of published articles using various study designs revealed a similar configuration as the Oxford hierarchy with meta-analysis and RCT receiving the most citations and case reports receiving negligible citations (Patsopoulos et al., 2005). Advocates of evidence based practice believe that practice based on research findings is more likely to result in desired patient outcomes across various settings (Youngblut & Brooten, 2001). While it is clear from the citation impact data that the academic community appreciates the scientific value of evidence from RCTs, we will see in the following section that practitioners value knowledge from a variety of sources to guide their practice, including the experiential knowledge of their colleagues and peers. Appreciation for the differences in value held by the academic community and the practice community is a necessary first step in articulating a process for blending different types of knowledge for use in practice.

Sources of Knowledge

The delivery of quality care involves bringing to bear the full breadth of available relevant health care knowledge to address a clinical issue. Different types of knowledge are available through a variety of sources. Different sources of knowledge are used at different times and selection is influenced by the issue at hand and the experiential knowledge of the individual clinician. Each knowledge source has inherent strengths and weaknesses that vary with the clinical scenario in which they are being applied and the preferences and skills of the individual clinician.

Clinical practice guidelines (CPG), clinical decisions rules (CDR) and systematic reviews are all knowledge tools that provide a synthesis of evidence and have been described as key sources of knowledge in practice. CPGs have been defined as “systematically developed statements to assist practitioner and patient decisions for specific clinical circumstances” (IOM, 1992). Rigorous methodological principles have been established to guide the development of clinically valid CPGs (Graham & Harrison, 2005; Grimshaw, Eccles, & Russell, 1995). CPG have been shown to improve health processes and outcomes (Grimshaw & Russell, 1993) however studies also demonstrate variation in the use of CPGs (Garfield & Garfield, 2000). Common reasons cited by physicians for not using CPGs is the failure to allow for clinical judgment and skepticism regarding the evidence (Flores, Lee, Bauchner, & Kastner, 2000; Carlsen & Norheim, 2008). CDRs, also designed using rigorous methodology, are a set of procedural algorithmic rules used to assist clinicians to make decisions in specific therapeutic and diagnostic situations (Laupacis, Sekar, & Stiell, 1997, Stiell & Wells, 1999). CDRs quantify the various components of the history, physical exam and laboratory test in diagnostic decision making (McGinn, Guyatt, Wyer, Naylor, Stiell, & Richardson, 2000). Although physicians report using CDRs to support their decision making they do not always use them in the manner in which the rule was intended, either adding or omitting specific variables (Brehaut, Stiell, Visentin & Graham, 2005). Both CPGs and CDRs integrate expert practice knowledge with empirical evidence. However, CDRs tend to be shorter than CPG’s and CDRs are validated in studies across clinical sites, whereas CPG’s often need to be adapted for a particular clinical context.

Systematic reviews are developed to answer specific clinical questions using well established methodology for summarizing research evidence (Manser & Walters, 2001; Mulrow, 1994). Narrative reviews, on the other hand, are useful for providing a broad perspective on a given topic (Cook, Mulrow, & Haynes, 1997). Many consider systematic reviews to be the best sources of knowledge for clinical and policy decision making (Laupacis & Straus, 2007). However, results are most useful when they are up-to-date (Moher, Tetzlaff, Tricco, Sampson, Altman, 2007). The Cochrane Collaboration is an organization dedicated to the development of systematic review methodology and the production and deployment of high-quality systematic reviews (Grimshaw, Santesso, Cumpston, Mayhew, & McGowan, 2006; Rowe & Brown,

2007). The strength of these three sources of knowledge lies not only in the systematic methodology used to develop them but also in the fact that they represent the synthesis of multiple sources and/or types of knowledge.

Research regarding preferred sources of knowledge varies across health disciplines and practice settings. One study examining a multidisciplinary group of health professionals reported use of a variety of sources to inform practice including scientific and professional journals, newsletters, and email alerts, which are accessed through the internet, informal networks such as colleagues and the library (Jackson, Baird, Davis-Reynolds, Smith, Balckburnt, & Allsebrook, 2007). Studies examining nurses preferred sources indicate nurses tend to rely on non-research sources of knowledge to inform their practice (Estabrooks, Scott-Findlay, & Winther, 2004; Estabrooks, et al., 2005). Impersonal sources such as journals or the internet are often sought only when personal sources come up short. Estabrooks et al (2005) conducted a cross-unit and cross organization study with 230 nurses from two Canadian provinces and found that nurses' primary sources of information were patient/clients, personal experience, and interactions with other nurses or physicians. A study of UK nurses found a similar preference for knowledge gained through interactions with other nurses, physicians and patients (Gerrish & Clayton, 2004). It is possible that personal sources at the point of care best suit their need for immediate solutions in practice. Clinical practice is very contextual requiring interpersonal interaction and experiential knowledge to make sense of the complexity (Estabrooks et al, 2005). Nurses have demonstrated a willingness to use online scientific evidence at the point of care to fill in gaps in their practice knowledge; however, adequate training and supportive leadership were important factors (Gosling & Westbrook, 2004).

The information seeking behavior of physicians is also characterized by use of a wide variation in sources, however text sources and asking colleagues ranked the highest (Dawes & Sampson, 2003; Davies, 2007). In a recent survey of US physicians regarding their information-seeking behaviors, participants reported consultation with colleagues as a preferred information source when unsure about diagnostic and management issues for a complex case (Bennett et al., 2006). There is some evidence to suggest that clinical specialty and location of practice may influence source selection. In a recent Canadian study, family physicians reported a preference for

secondary sources such as continuing medical education while specialist physician identified primary sources of evidence to support their practice (Beaulieu, Proulx, Jobin, Kugler, Gossard, Denis et al., 2008). Rural and urban primary care clinicians have the same needs for information and both groups rely on colleagues and personal libraries as their main sources of information (Dorsch, 2000). However, rural clinicians' access to information sources is limited by isolation, inadequate library sources, lack of skills, and poor computer infrastructure (Dee, 1993; Dorsch, 2000). Physicians often rely on personal experience to ground their clinical judgment showing a preference for experiential knowledge over explicit knowledge. (Andersson, Lindberg, & Troein, 2002). Physicians cite time constraints as a major barrier for seeking out explicit information sources to support their practice (Cogdill, Friedman, Jenkins, Mays, & Sharp, 2000; Davies, 2007). Time can be related to immediacy of the need, access to resources or inefficient search strategies. The context of a clinical scenario is generally an important consideration in clinical decision-making, however; quantitative research knowledge, as it is presented in scientific journals, is generally context free. In summary, research about preferred sources of knowledge for health professionals suggests there are some variation between disciplines however, overall clinicians report using a variety of sources. While it would seem that nurses are less inclined to use explicit sources of knowledge than physicians, the consistency with which all health care professionals report use of colleagues as a source of knowledge would suggest that clinicians require and appreciate an interactive process in negotiating the knowledge to practice journey.

Evidence Based Practice

The relationship between knowledge and clinical practice has created tension in the evidence based medicine debate. Twenty years after its first appearance in the medical literature evidence based medicine (EBM) and its partner evidence based practice (EBP) continue to be at the centre of an animated discourse. Early definitions of EBM alluded to the exclusive use of research evidence as a base for clinical decisions. "Evidence-based medicine de-emphasizes intuition, unsystematic clinical experience, and pathophysiologic rationale as sufficient grounds for clinical decision-making, and stresses the examination of evidence from clinical research." (Evidence-based Medicine Working Group, 1992, p. 2420). Revisions quickly followed which stressed

the importance of integrating individual clinical expertise (proficiency acquired through clinical experience and practice) with the best available external clinical evidence from systematic research (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). However, a basic assumption underlying EBM is “that practitioners whose practice is based on an understanding of evidence from applied health care research will provide superior patient care compared with practitioners who rely on understanding of basic mechanisms and their own clinical experience” (Haynes, 2002, p 2). At present, there does not appear to be any evidence in the literature to refute or support this basic assumption. In addition, a debate continues in the EBM literature regarding the value of different types of knowledge; in particular scientific knowledge versus experiential knowledge. Although EBM acknowledges other forms of knowledge it continues to rest on philosophical and epistemology assumptions that involve preferential use of research knowledge (Tonelli, 2006).

EBP has been readily adopted by a number of professional bodies and health disciplines including physiotherapy, occupational therapy, nursing and psychology. In nursing it is widely known as a problem solving approach that incorporates many forms of evidence (patient values, experiential or pathophysiologic knowledge) (Melnyk & Fineout-Overholt, 2005). The skills required to practice evidence based nursing (creating efficient search strategies, use of electronic databases, critical appraisal of the evidence) have been incorporated into most undergraduate nursing curricula (Burke, Schlenk, Sereika, Cohen, Happ, & Dorman, 2005). However, it is recognized that there is a need for development of this skill set in nurses who are already in the practice setting before nursing can fully engage in EBP (Hudson, Duke, Hass, & Varnell, 2008)

Challenges to Evidence Based Practice.

Although clinicians believe that evidence based practice improves care (Nagy, Lumby, McKinley, & Macfarlane, 2001; Wright, Brown, & Sloman, 1996) a number of challenges continue to exist in moving EBP forward as is demonstrated in one USA study that identified only 55% of care provided is based on evidence (McGlynn, Asch, Adams, Keesey, Hicks, DeCristofaro et al., 2003). Despite publication of best treatment practices in the research literature, treatments that have no effect or are

potentially harmful continue to be recommended (Antman, Pearce, Ireson & Love, 1992). A recent review of the literature identified numerous factors in the knowledge to practice gap related to the individual clinician (cognitive/behavioural, attitudinal, personal characteristics), the health care system or context (support/resource, system/process) and the evidence itself (Cochrane, Olson, Murray, Dupis, Tooman & Hayes, 2007). Unravelling the many factors that challenge the delivery of clinical care based on best evidence is messy but vitally important to the EBP agenda (Grol, 1997). As it currently stands EBM continues to be criticised on a number of fronts in the health care literature regarding the hierarchical structure of knowledge, the usefulness of decontextualized scientific knowledge in practice, and management of the expanding volume of published knowledge. The following paragraphs will briefly examine each of these criticisms.

A major concern regarding the EBM movement is the preferential emphasis on certain forms of knowledge and the prescribed hierarchical structure of knowledge. Holmes, Murray, Perron & Rail (2006) accuse the EBM movement of being fascist and suggests that it is “outrageously exclusionary and dangerously normative with regards to scientific knowledge” (pg. 182). Medical humanism would argue that EBM is “erasing and ignoring the patient” (Malterud, 2006, p. 292). Other critics argue that there is real potential for the practice of medicine to become “cookbook” in nature as clinicians are asked to rely on synthesized evidence prepared by authoritative experts (Rosenfeld, 2004). This would suggest a movement away from patient centred care and the use of individual clinical judgement. In addition, Tonelli (2006) argues that the various kinds of knowledge (RCTs, case report, patient and clinician experiential, etc) in the hierarchical structure are too dissimilar to be included under the same configuration and that each type of knowledge requires its own hierarchy. Each contributes to medical decision making and the mixture varies depending on the individual clinical scenario. It has been suggested that practice is too contextual for a fixed hierarchical structure (Hudson et al., 2008). The clinician must weigh knowledge from different sources and arrive at a conclusion that will lead to the best possible outcome for the individual patient. Tonelli (2006) refers to this as a casuistic model of clinical medicine.

The way in which some research knowledge is presented in journals or scientific reports can also make it challenging to apply in the practice setting (Nagy et al., 2001). In an evidence based medicine perspective, researchers contribute explicit knowledge to practitioners through journals publications and books (Bartunek et al., 2003). However, this knowledge is decontextualized and may be challenging to access in the context of practice. There is a strong emphasis on standardized care as provided by clinical practice guidelines and systematic reviews of randomized control trials which have been carried out under tightly controlled conditions. Clinicians in practice express concern regarding the setting in which the research is conducted and characteristics of the patient population. For example, primary care physicians have expressed concern about the changing nature of knowledge and have questioned the relevance of scientific knowledge produced in an academic setting to practice in their community settings (Beaulieu et al., 2008). RCTs include carefully chosen patients that may not represent a typical patient. Medical knowledge generated from groups requires careful negotiation when applied to individual patients (Malterud, 2001). Medical school curriculums are heavily laden with scientific knowledge which is consistent with evidenced based medicine; however, we know that clinical practice involves interpretive action and interaction with individual patients. The very nature of individual human clinicians with experiential knowledge working with individual human patients involves subjectivity (Malterud, 2001). Clinicians must be able to visualize how explicit knowledge presented in scientific journals can be applied in their practice. Scientific evidence by itself is unlikely to change clinical practice without acceptance by the knowledge users (Sekimoto, Imanaka, Kitano, Ishizaki, & Takhas, 2006). Further attention to the way research knowledge is derived and presented to the clinical practice and policy making communities is important for enhancing utilization.

The growing volume of scientific literature also poses a challenge for EBP enthusiasts. The volume of literature creates noise especially when only a small fraction of published literature actually represents new knowledge that is ready for transfer into practice (Haynes, 2002). Couple this with the publication bias for studies showing significant differences and some studies with significant findings can lead to multiple publications then the task of finding the right nugget of information is further increased.

Searching the literature is a core expectation in evidence-based practice, however it requires time and an expert skill set (Gerrish & Clayton, 2004). Information literacy skills include identifying an information need, identifying the right information and the retrieving and interpreting the information. The activity is fraught with error even when one identifies pre-authorized, pre-appraised checklists and evidence (Nunn, 2008). Wading through the volume of available scientific information to find the one nugget that addresses a specific clinical question is challenging. This is often a result of asking poorly formed questions which can result in a significant loss of time and frustration for busy practitioners (Melnyk & Fineout-Overholt, 2002). Critics suggest that evidence based practice falls short in recognizing the intellectual work required to relate specific information to the particular context in which it is being used (Purkis & Bjornsdottir, 2006). Several studies have also identified lack of knowledge and skills on the part of the clinician to evaluate the literature as a challenge to overcome (Melnyk, Fineout-Overholt, Feinstein, Li, Small, Wilcox et al., 2004; Nagy et al., 2001; Haynes 2002). Although guidelines for how to critical appraise the health care research literature are available online and in print (Haynes, 2002) it is unclear if clinicians are aware of their existence or use them.

Additional challenges to managing the overwhelming volume of literature is lack of access to resources, lack of administrative support and lack of mentorship (Melnyk et al, 2004). As the scholarly debate persists in the health care literature about the inconsistencies of EBM, issues such as the preference for one type or source of knowledge over another and management of the current format and volume of published evidence will continue to pose challenges until the EBM community take action to address them.

While the absolute reliance on explicit knowledge sources to guide decision making in practice is not favoured (Higgs & Titchen, 2001), critical appraisal of all evidence is important prior to use in practice. However, leveraging best practice knowledge from tacit sources also pose challenges to an EBP agenda. Literature published in peer-reviewed journals or included in CPG's undergoes a rigorous critique by experts in the field (Matthews & Bernardo, 2008). Experiential knowledge, on the other hand, can only be critiqued if shared. The availability of implicit or tacit knowledge for

critical appraisal can be limited by a number of factors related to the individual clinician (lack of willingness and skill to share) and the practice setting (culture that values knowledge, formal structures for sharing). The characteristics of tacit knowledge also influence how it is shared. Tacit knowledge is difficult to describe as it is embedded in experience, therefore sharing the context in which it was derived with the tacit knowledge is critical to its overall utility (Maqsood, Finegan, & Walker, 2004). Social interaction is known to improve decision performance; however, further research is needed to better understand how to tap the wealth of tacit knowledge embedded in practice (Handzic, 2000).

Knowledge in Emergency Practice

Examination of the literature on the exchange and use of knowledge in emergency practice settings suggests that there are 3 dimensions of influence 1. context of the emergency department (ED) practice setting, 2. characteristics of the individual clinician and 3. characteristics of the knowledge. The context of the ED practice setting poses some unique challenges to an evidence based practice agenda when compared with other clinical areas. The size of the ED, the volume and characteristics of the patient population and availability of expert resources may influence patient outcomes (Smith, 2002). Compared with a typical inpatient unit where the length of patient stay is generally predictable and clinicians generally have time to build a rapport with their patients, reflect on treatment alternatives and observe patient response to treatment, patient The volume and diversity of patient presentation in the ED is generally unpredictable. Most patients do not schedule their visits to the ED and the length of stay and thus the length of patient-physician contact time is generally much shorter when compared with inpatient units. In the ED, attention to patient flow is an integral component of the process of care. Inpatient units close or refuse patients when all the beds are full; however, patients continue to enter the ED even when all the beds are full and form a queue in the waiting room. The time from initial triage to assessment by physician to disposition is a key indicator of the quality of care provided in the ED, therefore the timely flow of patients through the ED is a priority. In an effort to manage patient flow, clinician-patient contact time is compressed into a shorter period than on regular inpatient units and decision-making is often time pressured. The high patient volume, high levels of diagnostic uncertainty, limited

clinician performance feedback, the multitude of interruptions and distractions, and the complexity of care in the ED contribute to creating an environment that is prone to errors (Burstin, 2002; Glatter, Martin & Lex, 2008). These practice context characteristics pose unique challenges for designing and developing successful interventions to enhance knowledge exchange and utilization in practice. Understanding the unique intricacies of the ED practice environment and exploration of how these might impact knowledge exchange and utilization is a critical first step in ensuring quality care in the ED.

Characteristics of the individual practitioners in the ED setting such as the extent of experiential knowledge, emergency specialization and information literacy skills are known to vary between and within EDs (Wadman, Muelleman, Hall, Tran, & Walker, 2005; Bhimani et al 2007). Factors related to the individual ED physician have also been found to be relevant to variation in prescribing of opioid analgesics (Tamayo-Sarver, Hilferty, & Fokes, 2004), ordering of CT scans for minor head injury (Klassen, Reed, Stiell, Nijssen-Jordan, Tenenbein, Joubert et al., 2000), management of acute asthma (Lougheed, Garvey, Chapman, Cicutto, Dales, Day et al., 2009), and use of sedation in children (Everitt, Younge, & Barnett, 2002). However, it is not exactly clear how or to what extent these factors impact knowledge exchange and utilization in the ED. Specialized training in emergency medicine and years of experience in an ED have been shown to influence the prescription of opioids and discharge analgesics in the ED (Heins et al, 2006). In one study exploring missed diagnosis of acute myocardial infarction (AMI), EDs with a higher annual volume of AMI had a significantly lower risk of missed diagnosis (Schull, Vermeulen, & Stukel, 2006). AMI patients presenting in lower volume EDs were assigned low-urgency triage scores and resources such as onsite consultants and ECGs at triage were more common in higher volume EDs. (Schull et al., 2006). The high volume presentations of specific medical conditions in an ED can create an opportunity for the accumulation of experiential knowledge related to that condition. Larger urban EDs are also likely to have better access to specialty consultation resources. Understanding how and under what conditions the characteristics of the ED clinician influence knowledge exchange and utilization is an important element in describing relevant barriers and facilitators.

Many scholars in emergency medicine acknowledge the limitations of EBM but value its usefulness in guiding practice and enhancing patient care (Doherty, 2005; Waeckerle, Cordell, Wyer, & Osborn, 1997). EBM is seen as process for facilitating the transfer of evidence into emergency practice (Waeckerle et al., 1997). In fact, although emergency medicine is a relatively new specialty, there are already over 150 systematic reviews held in the Cochrane library which are useful knowledge synthesis tools for emergency clinicians (Emond, Wyer, Brown, Cordell, Spooner & Rowe, 2002; The Cochrane Library, 2009). It is not surprising then that a number of explicit knowledge tools can be found in most EDs. Quality initiatives to support EBM in emergency practice settings involving best practice guidelines and performance feedback have met with some success but require commitment from multiple stakeholders for long term sustainability (Wright, Trott, Lindsell, Smith, & Gibler, 2008). Poor adherence to CPGs in emergency practice settings is a common finding in the research literature (Hsieh & Yealy, 2005). CPGs have been met with some scepticism due to concerns about methods used to develop the guidelines and the strength of the underlying evidence (Lang et al., 2007). CDRs are also particularly useful in emergency practice settings where decisions must often be made under significant time pressures. Croskerry (2006) suggests the decision making challenges in the ED is like no other clinical setting with the “variety, novelty, distraction, and chaos, all juxtaposed to a need for expeditious and judicious thinking” (p 713). Although studies show that emergency clinicians do use CDRs there is variation in the way in which they are applied (Brehaut, Stiell, & Graham, 2006). Most emergency clinicians report applying rules such as the Ottawa Ankles rules (Stiell et al, 1994) from memory yet their memory of even this simple rule is imperfect, suggesting the need for memory aids to support appropriate application (Brehaut et al., 2005). It would appear that while a number of explicit knowledge tools are available in many EDs, the uptake and application of such tools varies. Considering the complex and often chaotic nature of emergency practice, attention to the way in which evidence is packaged and presented in the ED is important.

Conclusion

While it is generally accepted that expert knowledge is necessary for good clinical practice, it is not always exactly clear what type of knowledge is needed in each practice scenario. We know that there are a variety of types of knowledge that are available and accessed through a number of sources in clinical practice settings. Clinicians report using different types and sources of knowledge to guide their practice, however, the use of respected colleagues is a commonly cited source across a number of studies. Choice of knowledge source is mediated by a number of factors including clinical experience, availability of sources and resources, information literacy skills, and urgency of the need. Emergency practice environments are knowledge intensive and incredibly complex with varied patient presentations and diverse clinician training and experience. The time pressure imposed by a focus on patient flow in the EDs presents unique challenges for knowledge exchange and utilization. Scarcely resourced rural practice settings pose additional challenges for clinicians who work in these areas. Identifying a clear and direct path for the exchange and use of knowledge in ED settings is challenging as a multitude of factors are likely to influence the process. These factors can generally be described under 3 dimensions of influence; 1. context of practice, 2. characteristics of the individual clinician and 3. characteristics of the knowledge . To date, one of the major limitations of implementations studies examining the knowledge to practice gap has been a lack of underlying theory to support the choice of intervention (Thompson, Estabrooks, Scott-Findlay, Moore, & Wallin, 2007; Rycroft-Malone, 2007). In fact, Eccles et al. (2005) would suggest that research in this area has been “an expensive version of trial and error” (p. 108) with varying results and limited contribution to understanding important questions in the field of study. The current lack of theory underlying research in the development of knowledge exchange and utilization strategies for ED settings poses a significant gap in the research literature. In the next chapter I will review knowledge exchange and utilization theories, models and frameworks that might be useful for examining the 3 dimensions of influence for knowledge exchange and utilization in ED settings.

Chapter 3: Knowledge Exchange and Utilization in Emergency Practice

Introduction

In this chapter I will provide a narrative review of the knowledge exchange and utilization theories, models and frameworks published in the health, social and information science literature which might be useful for examining the 3 dimensions of interest: 1. context of practice, 2. characteristics of the individual clinician and 3. characteristics of the knowledge. The topic of interest to this dissertation is knowledge exchange and utilization, therefore a search was conducted using Medline and CINAHL (1969-2005) with the keywords knowledge exchange, knowledge utilization, research utilization, and emergency medicine. Relevant websites (Canadian Health Services Research Foundation, Canadian Institute of Health Services Research, Knowledge Utilization Studies Program, and Knowledge Utilization Utilisation des Connaissances) and course syllabi (Topics in Knowledge Utilization, University of Alberta; Cognitive and Behavioural Theories for Knowledge Exchange, University of Ottawa; Knowledge Management for Health Informatics, Dalhousie University) were also searched. Papers were selected for review if they presented a model or framework for knowledge exchange and utilization and included examination of one or more of the 3 dimensions of interest for emergency practice settings; 1. context of practice, 2. characteristics of the individual clinician and 3. characteristics of knowledge. Models such as the Knowledge-to-Action Framework (Graham, Logan, Harrison, Straus, Tetroe, & Caswell et al, 2006), were excluded from this review if they focused on the broader concept of knowledge translation. Models that focused on evidence-based decision making, such as the one developed by Haynes, Devereaux, Guyatt and Gordon (2002), were also excluded as they focused on knowledge use by individual clinicians without consideration of knowledge exchange between clinicians.

Scholars interested in explaining and/or examining various aspects of the knowledge to practice phenomena have called for the use of conceptual models, theories or frameworks to ground all research and further develop the empirical knowledge base (Rycroft-Malone, 2007; Kitson, Rycroft-Malone, Harvey, McCormack, Seers, & Titchen, 2008; Kontos & Poland, 2009). Although the nomenclature for these

empirical structures are often used loosely and interchangeable in the research literature, conceptual models, theories and frameworks can generally be distinguished in terms of their level of specificity. A conceptual model is a symbolic representation of some phenomenon. It includes a set of abstract or broad concepts that are central to a particular field of study (Fawcett & Garity, 2009). A conceptual model can not be tested in its entirety; however, it can be used as a starting point to identify relevant research questions and to guide generation and testing of theories and hypothesis. Complex issues, such as knowledge exchange and utilization, benefit from model construction as it helps to create some order among the chaos of the phenomenon (Nieswiadomy, 1998). A theory is defined as two or more relatively concrete concepts (generally derived from a conceptual model) with a set of propositions statements that describe and associate the concepts (Fawcett & Garity, 2009). Although sometimes difficult to distinguish, in general, model concepts have a higher level of abstraction than theoretical concepts. Theories guide research in a more specific way than conceptual models and are generally directly related to the aims of a research project. The term framework, which is normally understood to provide more specificity and an organizing structure for describing a phenomenon, is often misused in the scholarly literature. Confusion is created when the term is tagged onto other empirical terms such as in the case of conceptual framework or theoretical framework. While there may be variation in the scholarly literature regarding the use of empirical nomenclature, there does appear to be consensus around the need for an underlying theoretical structure to support intervention research regarding the various components or activities of knowledge use in practice.

Knowledge exchange and utilization in emergency practice settings involves a variety of stakeholders and is influenced by characteristics of the individuals involved, characteristics of the context of practice and characteristics of the knowledge. Developing descriptions of each of these dimensions and understanding how they influence each other to facilitate the exchange and use of expert knowledge in emergency practice is critical. A conceptual model for knowledge exchange and utilization in emergency practice would serve as a guide for developing interventions, identifying research questions, or developing theories.

Finding Conceptual Clarity

Before examining the existing models and theories regarding knowledge exchange and utilization it is important to clarify some of the terminology currently in use in this field. The high degree of interest in exploring knowledge in practice is evident by the increasing number of manuscripts and indeed the number of journals which are now dedicated to such discussion. As in most new and emerging fields of study, confusion and misunderstanding around central concepts is common. Graham & Grimshaw (2005) conducted a study of 30 applied research funding agencies in 9 countries and identified 27 different terms describing some aspect of knowledge to practice. To complicate matters further, terms are often used interchangeably in the literature with a wide array of meanings generally ascribed to each term. In this section we will define the two constructs of interest in this dissertation (knowledge exchange and knowledge utilization) as well as some of the other commonly used terms often found embedded in this literature (knowledge translation, knowledge transfer, dissemination, diffusion).

The first construct of interest, **knowledge exchange**, is still relatively new to health care. Much of the literature on knowledge exchange in health care focuses primarily on the sharing of research knowledge between researchers and knowledge users (clinicians and policy makers) (Mitton, Adair, McKenzie, Patten, & Perry, 2007). The Canadian Health Services Research Foundation (CHSRF) has been a leader in knowledge exchange since its inception in 1997 and describes it “as collaborative problem-solving between researchers and decision makers” (CHSRF, 2008, http://www.chsrf.ca/knowledge_transfer/index_e.php). In this frame of reference, knowledge exchange is tightly connected with the research process. CHSRF has developed a number of tools and processes to facilitate and support interaction between researchers and decision makers or knowledge users. The Canadian Institute of Health Research (CIHR) also appreciates knowledge exchange as part of the research process. “Knowledge exchange or integrated knowledge translation (IKT)...involves active collaboration and exchange between researchers and knowledge users throughout the research process” (Gagnon, 2009, p. 240). However, this type of knowledge exchange represents only a small proportion of the knowledge

exchange activities in health care settings. Exchange between health care professionals accounts for the major part of information flow in practice settings (Parker & Coiera, 2000). Some of the common barriers cited for knowledge exchange in health care are time, information literacy, isolation, and a lack of belief that the information is available (Dorsch, 2000; Dawes & Sampson, 2003; D'Alessandro, Kreiter, & Peterson, 2004). While it is acknowledged that research funding agencies would likely preference the exchange of their product, research knowledge, it is also important to be aware of and realistic about the preferences of the user. Outside of health care, knowledge exchange is viewed more broadly and includes different types of knowledge (tacit or explicit) among heterogeneous or homogeneous groups (Thomas-Hunt, Ogden, & Neale, 2003; Herschel, Nemati, & Steiger, 2001). It is understood to be a two-way flow of knowledge, innovation, best practice, ideas and experience between community members. In information science a large body of research literature exists regarding information sharing across networks with an emphasis on who is speaking with whom and how knowledge or information flows through social networks (Cross, Parker, & Borgatti, 2002; Haythornthwaite, Kazmer, Robins, & Shoemaker, 2000). The concept of knowledge sharing is used interchangeably with knowledge exchange in the information science literature with an established body of research evidence on motivation for knowledge sharing (Hall 2001). Knowledge exchange is understood to be a precursor for successful decision making in the knowledge management and organizational learning literature as the knowledge needed to solve problems or complete tasks is often distributed across a number of individuals. A feature that appears common to all perspectives is that knowledge exchange is a social process that involves knowledge sharing between individuals or groups (Molm, 2001; Rycroft-Malone, 2004). In this program of research knowledge exchange refers to the seeking and sharing of all types of health care knowledge for the benefit of clinicians, researchers, patients and society at large.

The other major construct of interest to this dissertation is **knowledge utilization**. Although the study of knowledge utilization has its roots in the social sciences in the 1960s, recognition of the importance of knowledge in addressing the needs of society dates back to the early Greeks (Rich, 1979). In health care, knowledge utilization is often described as an action process where knowledge is applied in decision making or practice (Denis, Lehoux, & Champagne, 2004). Knowledge utilization is generally

understood to be individuals doing some activity (policy making, clinical decision making etc) with research results; however, definitions and indicators for *use* vary across populations studied and the preferences of the researcher (Beyer & Trice, 1982). To date the majority of the work in this field has focused on the *utilization* part of the term versus the *knowledge* part. This has led to challenges in moving the field forward as different types of knowledge are produced, diffused and used in different ways (Rich, 1991). This lack of specification has led to confusion in the health care literature where one can find examples of the term knowledge utilization used interchangeably with information utilization and research utilization (Estabrooks et al., 2003). To add to the confusion, describing exactly how knowledge gets used in practice is messy. A number of studies have been conducted across a variety of health care settings examining the use of knowledge in practice (Baessler, Blumberg, Cunningham, Curran, Fennessey, & Jacobs et al, 1994; Osmond, 2006) however; achieving consistency in reporting the *use* of knowledge in practice has been difficult. This is partially due to lack of specificity of the term *use* which has led to inadequate or inappropriate measurement strategies. Three types of use are generally reported in the research literature. *Instrumental use* is the most frequently reported and refers to the direct application of evidence into materials or tools such as guidelines or clinical decision tools for use in practice (Estabrooks et al., 2003). *Conceptual use* is less specific and involves the use of research results for general enlightenment. It is argued that the conceptual use of knowledge is more frequent than instrumental use however; the vagueness of the term makes it susceptible to over-reporting (Breyer & Trice, 1982). *Symbolic use* involves using research results to support or legitimize a decision or a position (Estabrooks, 2001). Beyer and Trice (1982) suggest that this form of use may be even more prevalent than conceptual use. For the purpose of this program of research I have adopted a broad conceptualization of knowledge utilization to encompass all three forms of use and to be inclusive of different types of knowledge. This appreciation for knowledge utilization is in keeping with a social constructivist paradigm which supports the idea that knowledge is not static and is constantly being deconstructed and reconstructed as individuals are exposed to and interact with new knowledge.

A concept that is relevant to this dissertation and in fact, encompasses knowledge exchange and utilization is **knowledge translation** (KT). KT is “a dynamic and

iterative process that includes synthesis, dissemination, exchange and ethically sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the health care system” (CIHR, 2007). KT is a broad concept that views research as a subset of knowledge (Tetroe, 2007). It focuses on changing health outcomes using evidence based clinical knowledge (Davis et al 2003). KT is an interactive process between researchers and a broad range of end users (policy makers, clinicians, patients, manager) and is a fundamental part of the mandate of the Canadian Institute of Health Research (CIHR) (Graham, Logan, Harrison, Straus, Tetroe, & Caswell, 2006; Straus Tetroe, & Graham, 2009). Other terms which are peripherally related to this dissertation topic include; **knowledge transfer**: generally understood to refer to a process of getting knowledge used by stakeholders (Graham et al., 2006), **knowledge dissemination**: the communication of research results through a targeted approach, tailoring the message for a particular audience (Graham et al., 2006) and **knowledge diffusion**: the passive dissemination of research knowledge through mechanisms such as scientific journals or presentations at conferences (Lomas, 1993).

Models, Theories and Frameworks of Knowledge Exchange and Use

As described earlier, models, theories or frameworks would be considered relevant to this project if they focused on knowledge exchange and utilization and included one or more of the 3 dimensions of interest for knowledge exchange and utilization in emergency practice settings; 1. context of practice, 2. characteristics of the individual clinician and 3. characteristics of knowledge. As the purpose of this program of research is to focus on factors specific to knowledge exchange and utilization, models and theories which focused on the broader concept of knowledge translation were not included in this work.

The publication of Everett Roger’s *Diffusion of Innovation* in the 1960s had a major influence on cross-disciplinary research regarding diffusion of innovations. Early diffusion research was situated within disciplinary silos (primarily sociology, anthropology and education) however, by the mid-1960’s the disciplinary boundaries began to break down (Rogers, 2003). The model has been used as an underlying framework to guide research related to knowledge exchange and utilization in health

care (Barta, 1995; Cobban, Edgington, & Clovis, 2008; Scott, Estabrooks, Allen & Pollock, 2008). In fact, early appreciation of the value of social networks for the diffusion of new ideas among physicians can be found in the sociology literature dating by to 1957 (Coleman, Katz, & Menzel, 1957). Roger’s defines diffusion as a social process in which an innovation (new idea) is “communicated through a channel over time among members of a social system” (Rogers, 2003, p. 11). This description is reflective of the social processes and knowledge sharing activities inherent in practice settings. Table 1 summarizes the four main elements in Rogers work.

Table 1. Summary of Roger’s Diffusion of Innovation

Element	Key Description Points
Innovation	<ul style="list-style-type: none"> -a new idea, practice or object perceived by and individual or an organization -may be planned or spontaneous - the characteristics of the innovation influence adoption (relative advantage, compatibility, complexity, trialability and observability)
Communication Channel	<ul style="list-style-type: none"> -relationships are important -interpersonal channels are generally more effective than mass media -presence of a champion who are homoplous enough to share meanings and language but heterogeneous enough to have some greater technical competence to share.
Time	<ul style="list-style-type: none"> - Innovation-decision process takes time and the rate of adoption generally follows an S-shaped curve -Innovativeness is the degree to which an individual or organization is earlier in adopting a new idea than other members
Social System	<ul style="list-style-type: none"> -structure of the social system can impede or facilitate diffusion -both formal and informal structures are important -members of a social system work together to solve problems similar to Community of Practice - how social or communication structures affect diffusion is under- researched

According to Rogers there are 5 variables that determine the rate of adoption of a new idea; 1. Attributes of the innovation 2. Type of innovation-decision 3. Communication channel 4. Nature of the social system and 5. Extent of change agents’ promotion efforts (Rogers, 2003). The process accounts for both the planned and unplanned spread of new ideas. This is an important consideration in clinical practice settings where a substantial amount of knowledge exchange occurs spontaneously when

discussing patients during shift changes, or sharing practice stories during quiet times or daily interactions between expert clinicians and novice trainees. However, while Rogers's model has contributed to understanding some of the important particulars of knowledge exchange and utilization in health care environments, the application in complex settings such as an ED is limited in a number of areas. First, the description of and appreciation for the individual provider in the exchange and utilization process is restricted. Rogers limits his description of the individual to those who are actively engaged in the process that in turn provides no insight into understanding those that do not adopt or use new knowledge. In addition, Roger's description of the individual adopter categories (innovator, early adopters, early majority, late majority, laggard) suggests that the innovativeness of an individual is static. An innovator in one situation would be an innovator in another. This assumption fails to account for the interaction between the experience of the individual practitioner, the context of practice (complexity of the patient scenario or resource availability) and the strength of the knowledge. The model also has a pro-innovation bias, assuming one size fits all, which fails to account for the need to adapt knowledge in rapidly changing clinical situations such as those that occur in EDs or in under-resourced rural EDs. Finally, the innovation-decision process in the model is described as a sequence of actions that occur in stages (Rogers, 2003, p. 169). This sequential, linear process does not reflect the complex nature of a busy ED, where constant interruptions, management of several acutely ill patients at the same time and unexpected changes in patient status can potentially derail the thinking and behavior of clinicians. While the Diffusion of Innovation model might have application as a general diffusion model at the health systems level, it has limited application in complex clinical practice settings such as an ED.

Greenhalgh et al, (2004) conducted a systematic review of the literature addressing the diffusion of innovations in service organizations. They used a meta-narrative review technique to synthesize the large and heterogeneous body of literature into a unifying Model of Diffusion in Service Organizations (Greenhalgh, Robert, Macfarlane, Bate, Kyriakidou & Peacock, 2005). The model is intended to represent what is known about the complex and non-linear nature of the diffusion process. Components of the model that are relevant to this dissertation include characteristics of the innovation, adopter attributes, the complex nature of the adoption process, the

importance of social networks and the characteristics of organizations that influence adoption of innovation (Greenhalgh et al., 2004). The strength of this work lies in the systematic method used to develop the model. However, the model fails to describe how the context of practice influences the diffusion process. The authors acknowledge this gap and identify the need for further research in understanding variations in the process of diffusion across particular contexts and settings. They also identify a deficit in published work regarding the complexities involved with spreading and sustaining innovations and recommend further attention on social networks and their usefulness as channels for social influence and improving the absorptive capacity of service organizations for new knowledge (Greenhalgh et al., 2004). EDs are knowledge intensive environments that provide diagnostic investigation, treatment, stabilization and short term management of patients who present with a wide range of medical, surgical or mental health emergencies. Rural and urban emergency practice clinicians manage similar patient population, however; the volume of patients, the mix of available clinical expertise and access to explicit knowledge sources varies across settings. These environments present unique knowledge diffusion challenges. While the Greenhalgh et al model represents a comprehensive summary of the diffusion of innovations literature it provides limited direction for understanding the context specific barriers and facilitators for knowledge exchange and utilization in complex practice environments such as rural and urban EDs.

Denis et al (2004) examined five commonly cited models that can be found in the knowledge utilization literature; *knowledge-driven, problem-solving, enlightenment, strategic, and interactive or deliberative*. Each of these models vary in terms of their definition of knowledge and the implied or explicit description of the relationship between the scientific community and the practice community. The *knowledge-driven mode* is heavily situated in the traditional academic vision in which scientists identify knowledge gaps in a given field, produce knowledge and make it available for the benefit of various organizations and societies (Denis et al., 2004, p.21). This is sometimes referred to as a science push model where an advance in research findings is the major stimulant for knowledge utilization activities (Landry, Amara, & Lamari, 2001). This model favors a passive diffusion of knowledge into the practice community; however the efficiency of the communication link will determine whether the best or most relevant information reaches the user (Weiss, 1979). This model has

been criticized for two reasons; 1. Knowledge transfer will not occur unless someone assumes responsibility for it and 2. Raw research knowledge is not usable in practice (Landry et al, 2001). These criticisms lead to the emergence of the *problem-solving model* where practitioners formulate requests for knowledge to scientists in order to solve problems or address gaps in clinical knowledge. This is also called the demand pull model and shifts the emphasis from the research to the user (Landry et al, 2001). In this model, knowledge has value only if practitioners can use it to solve critical problems in practice. Schon's work on the reflective practitioner which emphasizes the derivation of knowledge and identification of important knowledge gaps through reflection in practice is in keeping with the problem-solving model (Schon, 1983). However, this model has been criticized for its strong emphasis on the interests of the user and the instrumental use of research (Landry et al, 2001). Both of these models have been largely rejected in favor of models which emphasize an interactive linkage between researchers and users.

The *enlightenment model* is similar to the knowledge-driven model in that knowledge is seen as a valuable entity in and of itself (Denis et al., 2004). However, the relationships and the movement of knowledge between the science and practice community are haphazard. The emphasis in this model is on the conceptual use of knowledge. Knowledge has no definitive purpose in practice but rather it is used in a constructivist manner to help clinicians develop new ways of knowing and understanding problems (Weiss, 1979). Conversely, in the *strategic model*, knowledge is seen as a resource or an asset that has value in certain organizational or social contexts (Denis et al., 2004). This model aligns well with the symbolic use of knowledge in which knowledge is manipulated to legitimize particular positions or gain advantage in an organizational or social position.

The *interactive or deliberative model* sees knowledge co-produced through a high level of co-operation and collaboration between researchers and users (Denis et al., 2004). This model aligns well with participatory action research and demands a high level of interaction between knowledge producers and knowledge users. It is based on the premise that knowledge gains value through interpretation and shared understanding by all key stakeholders. While the interactive model has surfaced as the

avored approach to knowledge utilization, studies suggest that there are conditions under which different levels of researcher-user interaction may be more or less effective (Ginsburg, Lewis, Zackheim & Casebeer, 2007).

All 5 of these models focus specifically on the diffusion of scientific knowledge and the relationships between the scientific community and the practice community. The hierarchical structure implied limits the value of other ways of knowing. Although the problem-solving model acknowledges the existence of clinical practice knowledge, its value appears to be linked with influencing the production of new knowledge through research. While these models emphasize the value of linkages between the knowledge producers and the knowledge users, they provide limited value in understanding how knowledge derived from multiple sources is exchanged and used in complex practice settings such as an ED. Questions about practice are known to arise at the point of care for emergency clinicians (Graber, et al 2007). Attention to the factors that influence knowledge exchange and utilization in practice is of vital importance.

The *Promoting Action on Research Implementation in Health Services* (PARIHS) framework was proposed in 1998 by Kitson, Harvey & McCormack to address the linear nature of existing models. The PARIHS framework consists of three factors (evidence, context and facilitation) which function interdependently to influence the use of evidence in practice. Each of the factors is positioned on a continuum from high to low and the most successful implementation of evidence in practice occurs when each of the factors is at the high end of the continuum (Rycroft-Malone, Kitson, Harvey, McCormack, Seers, Titchen, & Estabrooks, 2002). The framework acknowledges that different types of knowledge are needed to address different patient problems and therefore evidence is broadly conceptualized to include research evidence (qualitative and quantitative), clinical experience or professional craft knowledge, patient experience and local data or information, each of which must be critically appraised (Rycroft-Malone, 2004). Critical appraisal of the evidence by individuals and teams is necessary regardless of the type used and generally involves a social process of critical reflection and debate to reach consensus on the value of the evidence (Rycroft-Malone, 2004). What remains unclear, however, is how an

individual clinician blends together different types of evidence to inform decision making. Context, in the PARIHS framework, is the environment or setting where health care is delivered and the use of evidence in a particular context is influenced by a range of social, cultural, psychosocial and political factors (Rycroft-Malone et al, 2002). Clarity of roles, decentralized decision making, transformational leadership and evaluation through multiple sources of information on performance are characteristic of organization contexts which are high users of evidence (Rycroft-Malone, 2004). Facilitation, the final element in the PARIHS framework, relates to the presence of an external or internal person who enables or helps individuals or teams implement evidence into their practice (Kitson et al, 1998). The facilitator role is concerned with enabling reflective learning by helping individuals to identify learning needs, guide group process and encourage critical thinking.

The PARIHS framework was developed specifically for health care environments and addresses some of the weaknesses in other models such as linearity or a focus on the tension between the scientific and practice community. However, a major limitation is their failure to acknowledge the critical role that the individual health care provider plays in the knowledge exchange and utilization process. Individuals are important units to consider in theories exploring the behaviour of clinicians towards health care knowledge (Glanz, Rimer, Lewis, 2002). Health care environments are composed of individuals and EDs are highly complex environments where clinicians rely on knowledge from multiple personal sources to make decisions (Croskerry, 2006). Failure to attend to the individual characteristics and behaviors of clinicians in the highly social knowledge exchange and utilization process is a major oversight in this framework.

Wenger's (1998) work on *Community of Practice* is another framework that has recently been associated with knowledge exchange in the health care literature. *Community of Practice* arises from the literature on social learning theory and is described as a group of people who share a concern or an interest in a set of problems or issues about a topic (Wenger, McDermott & Snyder, 2003). Interaction between members in a community of practice creates opportunity for sharing of artifacts, stories and resources (Sanders, 2004) and contributes to a meaningful experience for

practitioners as their interactions are generally tied to the context of their shared practice (Brown & Duguid, 2001). The framework has been used both as a tool and a theoretical framework to guide knowledge exchange studies with health care consumers and providers. The social processes inherent in a *community of practice* framework are very relevant in health care organizations as face-to-face communication with peers is a primary mechanism for information exchange in practice environments (Dawes & Sampson, 2003; Parboosing, 2002). In fact, it has been noted that interpersonal communication among practitioners accounts for a major portion of the information flow in health care (Parker & Coiera, 2000). Socialization has also been shown to enhance individual decision making (Handzic, 2000). As knowledge moves through communities or social networks it is transformed into a format that is more accessible for application or utilization (Latour, 1986). Knowledge needed to solve problems is often distributed over multiple human beings and a variety of tools and situational factors (Patel, 1998). Therefore, collaboration and communication are two critical elements in a successful knowledge exchange and utilization environment as these activities not only serve as the mechanism for knowledge explication but also serve as the medium for knowledge sharing. Through this process practitioners continuously construct and modify knowledge through interactions in everyday practice (Wenger, 2000). This social process can also provide an opportunity to blend knowledge from different sources with prior knowledge (Villasante & Garcia, 2001).

The community of practice framework highlights key elements of interest in this dissertation, namely the relationship between knowledge and practice and the importance of social networks for knowledge exchange between clinicians. However, the framework has limited applicability as an organizing structure for this dissertation as it fails to describe any of the dimensions of interest in this work. It is also unclear how the community of practice framework would hold up in a rapidly changing practice environment such as an ED.

Summary of Theories Reviewed

Variation in emergency practice has been found to exist both within and between EDs. Despite the existence of numerous models, theories and frameworks in the

health care literature, a useful model to describe knowledge exchange and utilization in a complex practice environment such as an emergency department does not exist (Table 2). Development of successful interventions to enhance knowledge exchange and utilization in emergency practice will require attending to the unique barriers and facilitators that exist in these settings. Although several of the models acknowledge the complexities inherent in facilitating knowledge exchange and utilization in clinical practice, few provide description of all three dimensions of interest (individual, context of practice, knowledge) and none attend to the challenges of knowledge exchange in a complex practice environments such rural or urban EDs. Clinical practice in an emergency department demands knowledge from different sources in terms of both published best evidence and case-based experiences of peers. While it is understood that collaboration and communication between the academic and practice communities is important for the production and exchange of scientific knowledge, this type of knowledge is only one of the many types that blend together to produce best evidence for use in practice. The deliberative process required for combining different forms of knowledge is a highly interactive, transparent and inclusive process that involves multiple stakeholders and acknowledgement of multiple types of knowledge (Lomas, Culyer, McCutcheon, McAuley, & Law, 2005). This type of process is not clearly visible in any of the existing knowledge exchange and utilization models nor is there appreciation for a complex practice environment such as an emergency care setting.

Table 2. Summary of Models/Frameworks Explored

Model	Explains the 3 Dimensions of Interest (individual, context of practice, knowledge)	Values exchange between practitioners	Appropriate for a rapidly changing complex clinical environment
Rogers Model Diffusion	No	Yes	No
Greenhalgh (2004)	No	Yes	No
Knowledge-driven model	No	No	No
Problem-solving model	No	No	No
Enlightenment model	No	No	No
Interactive or deliberative model	No	No	No

Model	Explains the 3 Dimensions of Interest (individual, context of practice, knowledge)	Values exchange between practitioners	Appropriate for a rapidly changing complex clinical environment
PARIHS	No	Yes	Yes
Community of Practice	No	Yes	Not clear

In practice, ED practitioners work in teams and collaborate to acquire and share their knowledge in order to address the knowledge gaps inherent within the healthcare system. However, given the interruptive nature of the ED setting it is challenging to sustain meaningful knowledge sharing activities amongst health care professionals. Communication loads on clinical staff in EDs are usually high and subject to multiple interruptions (Coiera, Jayasuriya, Hardy, Bannan, & Thorpe, 2002). This issue is of vital importance as poor communication has been well established in the research literature to contribute to adverse events (Thomas, Studdert, Burstin, Orav, Zeena & Williams, 2000; Haig, Sutton, & Whittington, 2006; Bartlett, Blais, Tamblyn, Clermont, & MacGibbon, 2008; Slade, 2008). There is a critical need for a knowledge exchange and utilization model that accounts for the individual characteristics of the emergency clinician, the complexity of the practice environment and attention to the broad spectrum of knowledge that is used in practice.

The Model of Knowledge Exchange and Utilization in Emergency Practice

EDs are knowledge-intensive environments which function with a baseline knowledge deficit (Shapiro, Kannry, Kushniruk, & Kuperman, 2007). The **Model for Knowledge Exchange and Utilization in Emergency Practice** (Figure 1) was developed to organize and describe the unique barriers and facilitators for knowledge exchange and utilization in rural and urban emergency practice settings. In the context of this model *knowledge* that is useful for practice is understood to arise from clinical experience, the experiences of patients and scientific inquiry. *Knowledge exchange* in this model refers to the seeking and sharing of emergency care knowledge between multidisciplinary emergency practitioners for the benefit of clinicians, researchers, educators, patients and society at large. *Knowledge utilization* is understood in the broadest sense as the explicit or tacit use of knowledge to support clinical or administrative decision making in emergency practice settings.

The Model for Knowledge Exchange and Utilization in Emergency Practice

draws on theories, models and explanations of knowledge utilization and knowledge exchange in the health science and social science literature and benefits from the experiential knowledge of the author as a clinician and an educator. It has emerged from several years of clinical experience in critical care settings, working with clinical preceptors and interdisciplinary health professionals as an educator, and as a researcher testing strategies to facilitate knowledge seeking and sharing in emergency practice settings. The model is based on the assumption that knowledge alone is insufficient to change practice. Situated on a foundation of collaborative practice and drawing from the literature on communities of practices, the model describes the barriers and facilitators to knowledge exchange and utilization in emergency practice settings. The model proposes that knowledge exchange and utilization is influenced by the relationship between three major dimensions: the individual clinician, the social, cultural and material context of practice and the characteristics of the innovation or the new knowledge being considered. The three dimensions (individual, practice context, innovation) work together synergistically to create conditions where knowledge flows freely among and between emergency practitioners in rural and urban EDs. Each dimension is characterized by a number of factors and the weight of influence of the factors may vary depending on the clinical scenario. In this first iteration of the model I have identified important factors commonly associated with each of the dimensions based on my experience as a clinical educator in the ED and a review of the literature.

Individual

Clinical practice is a highly social entity and the interaction between the individual actors sets the stage for good clinical practice. The individual in this model is understood to include all clinicians (interprofessional, multidisciplinary), administrators, researchers and educators who work in or influence an emergency practice setting. Knowledge seeking and sharing in practice occurs most often at the interpersonal level when questions or information needs arise during practice (Royle & Blythe, 1998; Gerrish, Ashworth, Lacey, & Bailey, 2008). Individual clinicians are the gatekeepers to the flow of knowledge in practice and as such play a central role in

the knowledge exchange and utilization phenomena. A variety of factors associated with the individual clinician have been identified as important in exploring the knowledge to practice gap (Barta, 1995). The **knowledge/skills, behaviours and characteristics** of the individual clinicians influence the extent to which they use and share knowledge. Lack of **knowledge and skills** related to information technology or critiquing of the research literature is a common barrier to sharing and using evidence in practice (Dunn, Crichton, Roe, Seers, & Williams, 1997; Nagy et al., 2001; Koehn & Lehman, 2008). The volume of health care information available through electronic sources requires a basic level of computer literacy skills, however; this is not the sum total of skills necessary to move knowledge into practice. Information literacy is the intersection of all skills necessary to determine, locate, evaluate and filter the information required for practice. Limitations in this skill set can hamper an individual's ability to actively engage in and benefit from knowledge seeking and sharing activities (McCaughan, Thompson, Cullum, Sheldon & Thompson, 2002). Identifying an information gap and formulating a good clinical question are the basic building blocks for knowledge seeking. Proficient information literacy skills guide a clinician towards development of an efficient information search strategy, reaching conclusions and communicating effectively. Emergency clinicians must be able to critically appraise the literature in order to interpret and apply results (Zed, Rowe, Loewen, & Abu-Laban, 2003).

A range of cognitive skills have also been identified as important in knowledge exchange and utilization. Critical thinking skills have been linked with research utilization (Profetto-McGrath et al 2003) and strong clinical reasoning and judgement skills are thought to be necessary to evaluate and merge knowledge from different sources. It has also been suggested that consideration of a parallel dual processing model of reasoning, which factors in a clinician's experiential and rational modes of thinking, may be useful when exploring an individual's use of knowledge in clinical decision making (Sladek, Phillips, & Bond, 2006). Practitioners will switch between experiential and rational modes depending on the patient scenario and their previous knowledge with managing similar cases. While decision making in the ED occurs in a complex social environment with many influences, the individual clinician has a significant degree of autonomy in terms of treatment and diagnostic decisions.

Appreciation for the individual differences in clinical reasoning is an important consideration when examining knowledge exchange and use in practice.

The **characteristics** and **behaviours** of clinicians as they relate to knowledge seeking and sharing are also important. The interdisciplinary nature of the work in an ED requires appreciation and respect for the knowledge and contribution of team members. A shared language and vision helps to build interpersonal trust and facilitates knowledge sharing (Mooradian, Renzl, & Matzler, 2006). Discussion of exceptional or rare patient presentations in the ED often initiates sharing of practice stories among clinicians. This tradition is common in urban EDs and often results in a valuable source of clinical knowledge for those who are present. The sharing of tacit knowledge by ED clinicians has the potential to become valued propositional knowledge through a process of debate, discussion and verification by the community of practitioners who participate (Rycroft-Malone, 2004). However, this activity can be limited by the size of the ED and the willingness of the individual clinicians to engage in knowledge exchange. Clinicians often cite their colleagues as a primary source of information when clinical questions arise in practice but they are also very deliberate in their choices, suggesting that some individuals are better sources of knowledge than others. This is also true of rural clinicians even though the pool of personal resources maybe smaller (Kosteniuk, D'Arcy, Stewart & Smith, 2006). The presence of an individual willing to function as a boundary spanner or participate in knowledge sharing in two communities (rural/urban or rural/rural), will help facilitate the exchange of knowledge between emergency practice settings (Russell, Greenhalgh, Boynton, & Rigby, 2004). There is a real opportunity to leverage boundary spanning activities in emergency practice settings as many physicians work in multiple EDs.

Participation in research activities has been associated with research use in practice (Bostrom & Strutter, 1993; McCleary & Brown, 2003). Participation in research projects, quality initiatives (QI) or education and orientation committees expose clinicians to new opportunities to discuss patient management and best practice. Many ED clinicians who actively use the research literature will share published studies relevant to emergency practice by posting a seminal article in their ED. However, an

individual's ability to interpret the study results may limit the usefulness of this information. EDs are composed of individual clinicians who work together to provide emergency care to patients under a variety of conditions. Attention to the attributes of the individual clinicians is important in understanding knowledge exchange and utilization in this fast paced practice environment.

Context of practice

In the **Model for Knowledge Exchange and Utilization in Emergency Practice** the dimension of *context of practice* is understood to mean the social, cultural and material elements of the setting or environment where emergency practice occurs. The term practice is defined broadly to include clinical, research and educational activities pertaining to emergency medicine. Context considerations can have multiple levels. Most EDs are part of a larger health care organization and as such are influenced by structures and process that govern the entire health centre. Organizational context has been cited in numerous health care studies as an important element influencing knowledge utilization in practice (McCormack, Kitson, Harvey, Rycroft-Malone, Titchen & Seers, 2002; Denis, Hebert, Langley, Lozeau, & Trottier, 2002; Cummings, Estabrooks, Midodzi, Wallin, & Hayduk, 2007).

Context of practice has been conceptualized in the Model for Knowledge Exchange and Utilization in Emergency Practice using three major elements: **structure, culture, and leadership**. In general, the presence of supportive organizational and departmental structures demonstrates a visible appreciation and value for knowledge exchange and utilization. This is of particular importance in rural settings where isolation and limited resources create unique challenges for knowledge utilization (Olade, 2004). Quality initiatives which assist in identifying learning needs/performance gaps and address measurement issues are important features in a supportive context and a starting point for knowledge implementation (Kochevar & Yano, 2006; Kitson & Straus, 2009). Activities such as morbidity and mortality rounds are useful forums for clinicians to reflect on clinical practice in their ED and compare with best practice initiatives on a national level. Evidence based quality improvement initiatives have been shown to improve care and enhance the use of

evidence in rural and urban emergency practice settings (Doherty & Jones, 2006; Wright et al., 2008). Intraorganizational and interorganizational networks that have been established around a common practice are useful for spreading knowledge among practitioners (Brown & Duguid, 2001). The importance of social processes and social networks can be seen throughout much of the literature on knowledge exchange (Denis et al, 2002; Rogers, 2003; Greenhalgh et al., 2004; Rycroft-Malone et al, 2002). Research demonstrates that it is the interaction with others that makes knowledge exchange useful, as new knowledge generally arises through a social process in daily practice (Haythornthwaite, 2006). There is a pressing need for organizations to identify strategies which support and encourage individuals to openly and freely share their practice knowledge (Hall, 2001). The establishment of a variety of structures to support knowledge exchange within and between emergency practice settings is not only critical to facilitate knowledge flow but also knowledge construction. The variety of structures should include synchronous (real time) and asynchronous (distributed) strategies to accommodate the interruptive nature and the size and skill mix variation across ED settings. Collaborative technologies such as electronic discussion boards have been shown to facilitate knowledge sharing among time-challenged and geographically dispersed rural and urban practitioners (Curran & Abidi, 2007; Curran et al., 2009). These structures would also support interdisciplinary collaboration and communication. Collaborative reflection in practice creates an opportunity to bring multiple sources of knowledge to bear on a patient issue. Such structures could allow for the exploration and discussion of contextually relevant patient problems with relevant stakeholders.

Lack of time has been cited as a major barrier for knowledge seeking and sharing and the use of evidence in practice (Melnyk et al 2004; Gerrish et al, 2008; Koehn & Lehman, 2008). Strategies which facilitate efficient access to knowledge could address many of the time related barriers. Accessible information technology at the point of care could provide opportunities for clinicians to access knowledge as the need arises (Sackett et al, 1998; Ebell, Messimer, Barry, Straus, & Sackett, 1999). Web-based teaching tools have also been used successfully to bring best practice knowledge to clinicians at the bedside (Belda, Gajic, Rabatin, & Harrison, 2004). Accessible and visible knowledge resources and evidence-based patient management

tools such as information technology, clinical practice guidelines and clinical decision rules can help reduce the time associated with knowledge seeking activities.

Having the necessary structural elements in place to facilitate knowledge exchange and utilization is an important first step in the process. However, clinicians must also see discernible appreciation for knowledge exchange and utilization embedded in the fabric of the organization through the strategic plan and detailed job profiles. ED culture and leadership play a pivotal role in demonstrating value for knowledge in practice and ensuring that knowledge is accessible and used to its fullest extent. Knowledge is a valuable asset that must be taken into account at the strategic and operating levels of organizations (Miles, Miles, Perrone, & Edvinsson, 1998). A unit culture where routine care is set by traditional practices and a hierarchical structure which limits innovation and questioning can severely reduce knowledge exchange and use (Scott & Pollock, 2008). A visible demonstration of valuing knowledge, collaboration and lifelong learning is essential.

Practice environments where uncertainty is high (unstable patient status, inconsistencies in management, unpredictable nature of work) can create barriers to the use of evidence in practice (Scott et al., 2008). In emergency practice settings, staff skill mix can vary as expert and novice staff work together collaboratively to manage patient flow. Rural ED settings face additional challenges as formal emergency specialization is uncommon and clinicians often work with limited access to knowledge resources. An organizational culture that values collaboration and knowledge sharing is important for benchmarking best practice (O'Dell & Grayson, 1998; Wasko & Faraj, 2005). A culture that demonstrates appreciation for knowledge in practice and shared decision making can assist in mediating uncertainty in complex practice environments.

Lack of administrative support and mentorship has been cited as barriers to the use of evidence in practice (Nagy et al., 2001; Melnyk et al., 2004; Watson, Clarke, Swallow, & Forster, 2005). A visible leadership infrastructure is necessary to support and sustain knowledge exchange and utilization activities. In most rural and urban EDs, patient management is a shared responsibility. Questions that arise in practice

should be explored and shared amongst the practice community. However, it is recognized that there is a need for organizational slack to allow the time for adequate exploration of clinical questions. A visible presence of leadership in the practice area demonstrates a commitment to good clinical practice and provides an opportunity to champion and role model a collaborative practice model. Knowledge sharing in a vibrant community of practice involving clinician scientists, researchers, administrators and practitioners can create opportunities to bring multiple types of knowledge together in a meaningful way to address patient care issues. The identification of local opinion leaders and champions to assist with dissemination and implementation of best practice initiatives has also been shown to be beneficial (Dopson, Fitzgerald, Ferlie, Gabby, & Locock, 2002; Doumit, Gattellari, Grimshaw, & O'Brien, 2007).

Knowledge

The third dimension of interest in this model, *knowledge*, is understood to be a dynamic entity. A basic assumption in the **Model for Knowledge Exchange and Utilization in Emergency Practice** is that clinicians use different types of knowledge from multiple sources to address clinical questions. Experts in the KT field agree that the best evidence to guide practice is derived from different types of knowledge including research, clinical experience, patient information and local data (Rycroft-Malone, 2004; Lomas et al., 2005). While it is not quite clear how these types of knowledge are blended together, collaboration and critical thinking are considered to be important in the process. The characteristics of the available knowledge have implications for its mobility and efficiency in practice (Royle & Blythe, 1998). Key characteristics of knowledge that are important in this model are *relevance, linkage with patient outcomes, availability, flexibility, trialability, complexity, and compatibility with existing values and beliefs*. Clinicians are unlikely to be interested in knowledge which they feel is not relevant to their practice (Sudsawad, 2005; Mickan & Askew, 2006). From a research and continuing education perspective this would suggest the importance of focusing on clinically meaningful questions. Knowledge that is clinically relevant may have a stronger likelihood of flowing therefore linking new knowledge to patient outcomes is important. Relevance may

also be subject to seasonal (ie asthma) or geographic (ie. Industrial accidents) trends and therefore may influence exchange and utilization.

Much of the knowledge that is currently available is not accessible for clinicians to use at the bedside (Nagy et al., 2001; Rowe, Diner, Camargo, Worster, Colacone & Wyer, 2007). A number of factors contribute to this. First, the current volume of research literature creates noise as only a small fraction of the volume of published literature represents new knowledge that is ready for transfer into practice (Haynes, 2002). However, distillation of knowledge through systematic reviews may alleviate some of the issues related to managing the volume of scientific literature. Second, the scientific language used to report the results of research studies is often confusing to clinicians in practice (Rowe et al, 2007). Evidence must be understood by clinicians if it is to be used in practice (Haynes & Haines, 1998). Third, smaller EDs with limited staff have fewer expert clinician resources. Clinicians most often seek evidence from their colleagues rather than explicit sources because the time required to get the needed information is often shorter. However, a limited staff volume and skill mix can pose a significant barrier for this type of knowledge exchange. Finally, emergency clinicians have demonstrated a willingness to use clinical practice guidelines and clinical decision rules however there is variation in the way this evidence has been applied across practice settings. New knowledge that is presented in a format that is flexible for use in a variety of situations and environments will be of greater interest and value to emergency clinicians. A new idea that is tied to a particular resource that is not available in smaller centres is unlikely to gain momentum. Emergency clinicians work in complex environments where patient presentation is unpredictable, therefore information must be available in a format that is readily accessible for immediate use.

Complexity, triability and compatabilty have also been identified as important characteristics that influence the adoption of a new idea (Rogers, 2003). Knowledge that is too complex or difficult to understand is unlikely to gain traction in the knowledge exchange process. New knowledge embedded in lengthy reports with weak application in emergency practice environments pose a challenge for busy clinicians (Rowe et al., 2007). Research has demonstrated that while emergency clinicians report using clinical decision rules to guide practice, their memory of even

simple rules is imperfect (Brehaut et al, 2005). This might suggest that complex rules or guidelines are unlikely to be applied as intended. In addition, knowledge that is connected with a complex or high risk patient scenario may pose unique challenges for exchange and use. Emergency clinicians must feel confident that the benefits of applying the new knowledge outweigh the risks. Embracing new clinical knowledge or a new idea is often challenging if the innovation requires a complex change in clinical practice (Grol & Grimshaw, 2003). Therefore, knowledge that is shown to enhance work efficiencies and improves patient outcomes is more likely to be used. The introduction of knowledge that is not compatible with the existing beliefs and values of the emergency department clinicians is unlikely to lead bear fruit (Powell, 2003; Sackett et al., 2001). It is essential to provide an opportunity to critique and scrutinise new knowledge within the local context and environment. Evidence that is locally constructed and thus compatible with clinicians existing values may be more meaningful.

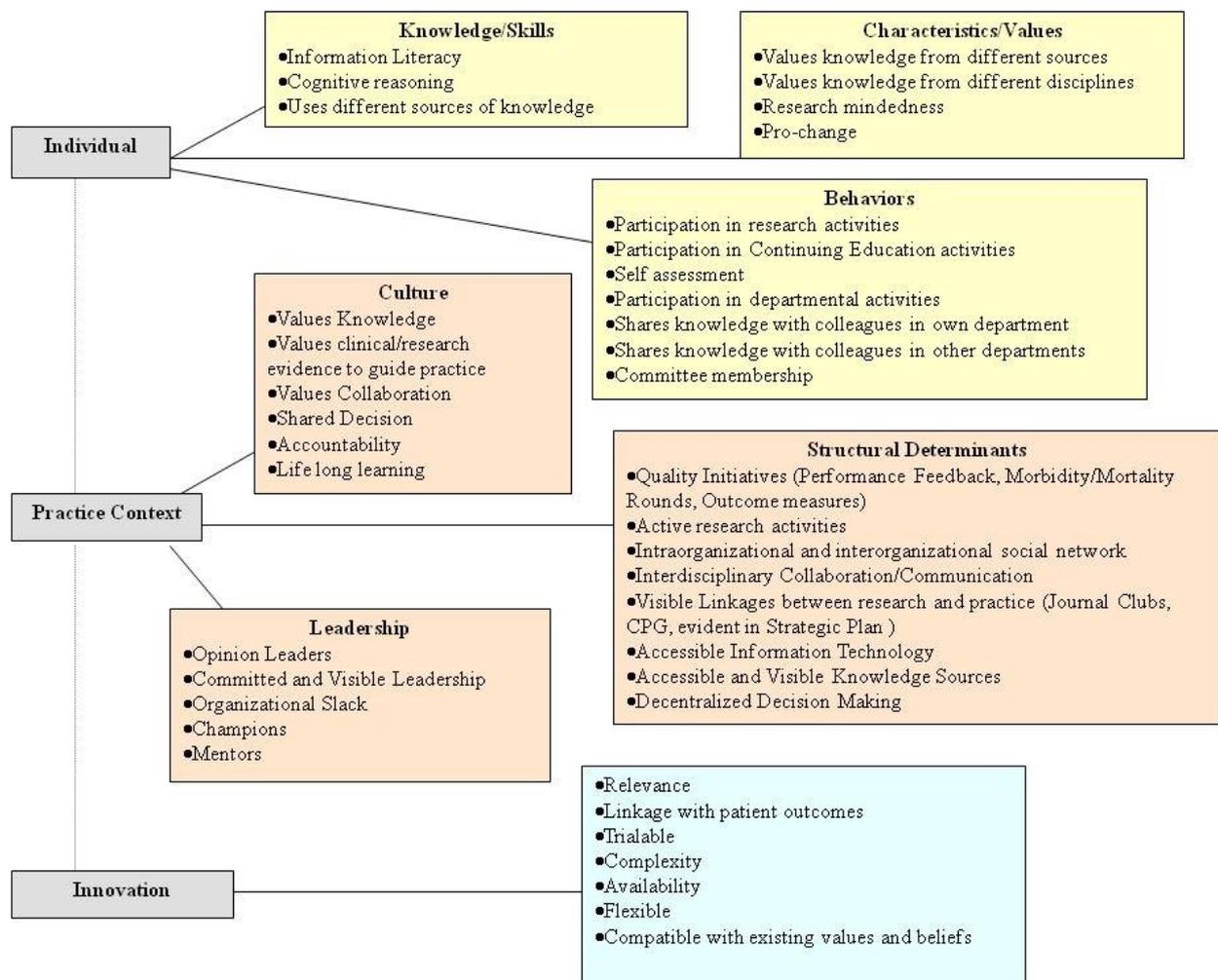
Relationship of Constructs

Knowledge exchange and utilization in emergency practice settings is a complex and dynamic process. Although the model diagram depicts the dimensions in a linear format, it is proposed that all three dimensions of this model (individual, context of practice, knowledge) work together synergistically to contribute to the knowledge exchange and utilization process, however; it is difficult to describe the nature of the relationship between the dimensions at this early stage of development. Identifying the barriers and facilitators of each dimension under different conditions should help elucidate important information about the relationship.

Conclusion

While it is agreed that knowledge exchange and utilization is important for minimizing the knowledge-to-practice gap, identifying a conceptual model which describes knowledge exchange and utilization in clinical practice settings is challenging. Further, many scholars advocate attending to the unique barriers and facilitators which exist across different practice settings when developing effective intervention strategies (Grol & Grimshaw, 2003). Emergency practitioners work in a complex environment where patient flow and presentation is unpredictable. Clinicians who work in rural EDs manage a similar patient population with a disproportionate

complement of resources. Creating opportunities where meaningful knowledge exchange can occur within and across emergency practice settings may facilitate the construction and use of best practice knowledge. A conceptual model for knowledge exchange and utilization in emergency practice is needed to serve as a guide for developing interventions, identifying relevant research questions, or developing theories. The **Model for Knowledge Exchange and Utilization in Emergency Practice** describes three dimensions (individual, context of practice, knowledge) which are thought to influence knowledge exchange and utilization across emergency practice settings. This model may serve as a useful framework to guide further exploration of this important phenomenon in emergency care.



February 2006, Janet Curran

Figure 1. Model for Knowledge Exchange and Utilization in Emergency Practice

Chapter 4: Studies

Introduction

Knowledge exchange and utilization in emergency practice settings is a multifaceted phenomenon. The process is influenced by a number of factors which interact at multiple levels; the individual, the context of practice, and the knowledge.

Understanding the complexity inherent in the process requires a diversity of views. A mixed methods research design will provide an opportunity for presenting a variety of potentially divergent views, leading to a richer understanding of this complex phenomenon. This program of research is grounded in both qualitative and quantitative methodology, each of which contributes a unique perspective in understanding knowledge exchange and utilization in emergency practice settings.

Mixed Methods Designs

Choice of research design should be guided by the research question. Qualitative and quantitative approaches arise from different epistemological perspectives and each has inherent strengths and weaknesses. Quantitative approaches are generally linked with the positivist paradigm and involve an objective process to describe and test causal relationships among variables (Burns & Grove, 2005). Quantitative designs typically use one or more measurement tools that have been selected or developed by the researcher with data analysis generally following the data collection process (Fawcett & Garity, 2009). There are a variety of quantitative research designs and each has a specific purpose. Descriptive designs are useful for generating new knowledge about a concept or topic for which there is limited or no research and correlational and quasi-experimental designs are useful for examining relationships between two or more variables (Burns & Grove, 2009). Qualitative research involves an interpretive, naturalistic approach with the researcher as an active participant in the process of inquiry (Denzin & Lincoln, 2005). Qualitative methods are useful for the study of human and social experience, communication, attitudes, meaning, interaction, and relationships; all important components of clinical knowledge (Malterud, 2001).

A third methodology, mixed method research, is a method of inquiry that is still quite new but has gained in popularity over the past 20 years (Teddlie & Tashakkori, 2003). Mixed methods designs incorporate techniques from both qualitative and quantitative methods to answer research questions (Teddlie & Tashakkori, 2003). Various terms can be found in the research literature describing mixed method designs; mixed methods research, multimethod designs or method triangulation. Mixed methods research involves the use of qualitative and quantitative methods in a single study where the data is collected concurrently or sequentially (Teddlie & Tashakkori, 2003). Whereas, in a multimethod design, qualitative and quantitative projects, which answer sub-questions in a program of research, are used together to form a comprehensive whole (Morse, 2003). The term triangulation has been broadly defined as the combination of two or more theories, methods, investigators, or data sources in one study (Denzin, 1989). Thurmond (2001) suggests that one of the benefits of method triangulation is the potential for exposing meaningful information that may have been missed or undiscovered with only one approach. The use of a mixed method design to examine questions of interest in health services research has increased over the last ten years (O’Cathain, Murphy, & Nicholl, 2007). This approach has been used effectively in numerous studies examining evidence-practice issues and exploring health care provider behavior (Walker, 2001; Hrisos, Eccles, Francis, Bosch, Johnston, & Grol, 2009). A mixed methods approach has also been used in emergency medicine to explore the research capacity of an interdisciplinary emergency clinical team (Short, Holdgate, Ahern, & Morris, 2009) and to describe the barriers for appropriate health system interventions in emergency care (Nelson, Dierberg, Scepanovic, Mitrovic, Vuksanovic, & Milic, 2005). The focus of interest in this research project is knowledge exchange and utilization in emergency practice settings. The research questions related to this focus involve exploring the behavior and experiences of a community of rural and urban emergency practitioners. The lack of current research evidence in this area and the complexities surrounding the research questions require comparing multiple perspectives; therefore a multimethod design was employed with data triangulation at the end of the three studies. The design for this project arose from a dialectic stance which assumes all paradigms have something to offer and the use of multiple paradigms contributes to a richer understanding.

Mixed methods designs have been the focus of some debate in the health services literature. Advantages that have been cited for the use of mixed methods include the addition of scope and breadth to a study, to identify outliers or unique cases, to achieve convergence or to explore contradictions in findings (Duffy, 1987; Greene, Caracelli & Graham, 1989; Monti & Tingen, 1999). It is also been suggested that the use of a mixed method design can compensate for the weakness in any single research design (Bryman, 2001) thus providing better or stronger inferences (Teddlie & Tashakkori, 2003). Scientific rigor can be improved through the discussion and challenge of convergent and unique findings (Jones & Bugge, 2006). Perhaps one of the most common controversies surrounding mixed methods designs is the argument that qualitative and quantitative methods are incompatible as they arise from different paradigms. This concern is likely a carry-over from the paradigm wars played out in the research methods literature during the 1970's and 1980's and reflective of the divide between positivism and interpretivism at that time. However, a basic assumption in mixed methods research is that the integration of multiple perspectives or worldviews leads to a richer understanding of a phenomenon (Teddlie & Tashakkori, 2003). The epistemological position of method triangulation suggests that various types of knowledge are required to understand a phenomenon and different domains tap different kinds of knowledge (Foss & Ellefsen, 2002). This epistemological position is well suited for examining the **Model for Knowledge Exchange and Utilization in Emergency Practice** which also acknowledges the importance of different types of knowledge to inform practice.

This program of research employed quantitative and qualitative methods sequentially through a series of three studies. Both methods were given equal priority. Data were gathered from physicians and nurses working in rural and urban emergency departments in Nova Scotia using self-report questionnaires, participant observations, interviews, and telephone surveys. Data triangulation was employed following the final study to synthesize the study results. Data triangulation involves the use of data collected from a variety of sources, over different times and spaces (Thurmond, 2001). The underlying premise in this project was that one method alone would not adequately elucidate the intricacies of the model components. Therefore a mixed method design using a multiple triangulation approach was chosen for the primary purpose of 1. Adding scope and breath to the project findings 2. Achieving

convergence of results and 3. Identifying and examining contradictions obtained from the multiple sources.

Study I

Introduction

Knowledge (research, clinical, and patient information), is key in the delivery of quality care. In many health care settings interaction among peers is a primary mechanism for knowledge exchange and learning (Dawes & Sampson, 2003; Parboosing, 2002). Interaction among members in a community of practice creates an opportunity for the sharing of resources (Sanders, 2004) and contributes to a meaningful experience for participants as the interactions are generally tied to the context of their shared practice (Brown & Duguid, 1991). However, in a busy pediatric emergency department (ED) the complexity of patient care, shift work, and the interruptive nature of the environment create less than ideal conditions for sustained, meaningful information sharing. Further challenges exist in smaller rural EDs where staff skill mix, fewer pediatric patient numbers and limited access to current, reliable resources restrict exposure to new information and knowledge. A multidisciplinary web based knowledge sharing intervention was developed to facilitate asynchronous knowledge exchange between rural and urban emergency clinicians in Nova Scotia. The *Multidisciplinary Pediatric Emergency Care Web Based Learning Project* (Curran, Murphy, Sinclair, & Best, 2006) was a multicentre, multidisciplinary intervention study exploring the usefulness of an online environment for learning and knowledge exchange regarding pediatric emergency care in Nova Scotia. This web based knowledge exchange intervention was an interactive virtual learning space which contained 12 multimedia learning modules developed and presented by expert emergency physicians in Nova Scotia. The modules offered best practice knowledge on 12 topics identified through a needs assessment prior to the study. An asynchronous discussion board provided clinicians from participating EDs with an opportunity to discuss cases, issues or questions relevant to any of the 12 topics.

Although the availability of internet access in the emergency department was a prerequisite for participation in the project, it is unclear what other barriers and

facilitators would contribute to clinician participation in this web based knowledge exchange intervention.

Formal evaluation of knowledge exchange interventions presents as a gap in the knowledge transfer and exchange literature (Mitton et al, 2004). The overall goal for Study I was to evaluate the utility of the **Model for Knowledge Exchange and Utilization in Emergency Practice** for explaining emergency clinician's participation in the *Multidisciplinary Pediatric Emergency Care Web Based Learning Project*. The model describes three dimensions (individual, context of practice, knowledge) which may influence knowledge exchange and utilization across emergency practice settings. The primary outcome of the *Multidisciplinary Pediatric Emergency Care Web Based Learning Project* is presented elsewhere (Curran et al., 2006; Curran et al., 2007) and is not part of this dissertation.

Research Questions

1. Are there specific individual, practice context or knowledge factors which impact participation in the web based knowledge exchange intervention?
2. What are the individual practitioner's perceptions of their organizations expectations regarding the use of knowledge in practice?
3. What are the preferred sources of knowledge used by rural and urban emergency nurses and physicians to guide practice?

Methods

Participants and Sampling

Project participants (n = 187) for this study were emergency clinicians who participated in the *Multidisciplinary Pediatric Emergency Care Web Based Learning Project*. This included 32 physicians, 146 nurses and 9 pharmacists working in 9 rural and 2 urban emergency departments in Nova Scotia. This purposive sampling technique presented an opportunity to gather information from a group of emergency clinicians who were invited to participate in the same knowledge sharing experience.

Survey Development

To understand how or if the three dimensions of interest in this dissertation (individual, context, knowledge) influenced participation in *Multidisciplinary Pediatric Emergency Care Web Based Learning Project*, the **Model for Knowledge Exchange and Utilization in Emergency Practice** was used to guide development of a 23 item self report survey. Items were developed to capture data related to the three dimensions in the model; individual, practice context and knowledge. A minimum of three items were developed for each dimension. Items included under the individual dimension reflected elements that were particular to the characteristics or behaviours of the individual clinician. These items were intended to gather data on the preferred knowledge sources and knowledge exchange activities of the individual clinician. Items included under the context of practice dimension were reflective of the culture, structure and nature of the ED practice setting. These items gathered data on knowledge exchange structures and processes that were outside the control of the individual clinician. As the *Multidisciplinary Pediatric Emergency Care Web Based Learning Project* was intended to expose clinicians to an innovative knowledge exchange intervention, items included under the knowledge dimension reflected activities and behaviours relevant to the use of web based technology for knowledge exchange. Responses were scored on a 4-point Likert scale (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree). A panel of 5 content experts (2 physicians, 3 nurses) reviewed the survey for face validity. Minor revisions were made to 4 survey items based on this expert feedback. The final survey (Appendix A) included 10 items on the individual dimension, 9 items for the practice context dimension, and 4 items reflecting the knowledge dimension. Demographic data regarding the participant's age, gender, discipline, years of emergency experience, additional education and certification achieved, computer literacy and practice location were also captured.

Data collection

The *Multidisciplinary Pediatric Emergency Care Web Based Learning Project* occurred between February 2004 and December 2005. Data collection for Study I occurred between January 2006 and March 2006. Surveys were mailed to each of the study site coordinators for distribution to study participants via the internal health centre mailing system. Site coordinators were instructed to send out one reminder email to all participants two weeks after the initial distribution. Each survey package included a letter of instruction directing the participant to return completed surveys to

the site coordinator in a sealed envelope provided in their survey package. Each site coordinator was provided with a postage paid courier envelope to return completed surveys to the Principal Investigator. This study was approved by the Research Ethics Board at the IWK Health centre.

Analysis

Survey item responses were entered in SPSS Version 15. Data was checked and cleaned through examination of frequency distributions and crosstabulations to highlight data entry errors, missing data and outliers. Missing data was replaced by item mode when less than 5% of item data was missing. Descriptive statistics (mean, mode, standard deviation and quartile range) and stem-leaf plots were generated for all items. Internal consistency (reliability) of the survey tool was checked using Cronbach's alpha. Exploratory factor analysis was carried out to summarize the patterns of correlation between the survey items and evaluate the validity of the subscales. Chi square and Fishers Exact test was used to determine if there was a relationship between items in the three dimensions (individual, practice context, knowledge) and the participants' decision to take part in the knowledge sharing intervention. Mann-Whitney U test was used to determine if there was a difference between rural and urban clinicians preferred sources of knowledge or perceptions of organizational expectations regarding knowledge use. Logistic regression analysis was planned to determine which variables best predicted participation in the web based knowledge exchange intervention.

Results

Demographic Characteristics

One hundred seven surveys were returned however, two surveys were removed because only demographics sections were completed, resulting in a 55% (105/189) return rate. The majority of respondents were nurses (87/104, 84%) and slightly more than half were from rural settings (59/105, 56%). This distribution is similar to the demographic distribution of the sampling frame (N= 189, 17% physicians, 42 % urban) (Table 3.). Of the survey respondents, 43% (45/105) participated in the knowledge exchange intervention. Almost $\frac{3}{4}$ of the sample (74%) were between the ages of 31 and 50. The majority of respondents (63/104; 61%) did not have emergency

certification in nursing or medicine and 43% of participants had greater than 10 years of experience in emergency practice (Table 3).

Table 3. Demographics of survey respondents in Study I

Demographic		Number	Percentage
Age	20 - 30	8	8
	31 - 40	37	36
	41 - 50	37	36
	51 - 60	20	19
	61 - 70	2	2
Setting	Rural	59	56
	Urban	46	44
Discipline (missing=1)	Physician	17	16
	Nurse	87	84
Gender (missing=1)	Male	15	14
	Female	89	86
Advanced Cert. Training (missing=1)	Yes	38	37
	No	66	64
Years ED experience	<1	1	1
	1-3	14	13
	4-6	30	29
	7-9	11	11
	>10	45	43

The reliability of the 23 item scale was strong with a Cronbach's Alpha .841. The subscales as planned during survey development also demonstrated good or strong internal consistency (Context, $\alpha = .755$; Individual, $\alpha = .693$; Knowledge, $\alpha = .786$).

The majority of respondents have adequate access to many explicit knowledge sources however, limited access to a librarian to assist with using these resources (Table 4). Although more than 50% of respondents report adequate access to paper journals (57/105 or 54%) and online journals (68/105 or 65%), less than half report using them to address questions that arise in practice (paper journals, 37%; online journals, 30%). Participants report relying on physicians (92%) and nurses (69%) from their own ED as primary sources of knowledge about paediatric emergency care. However, there is limited (nurses, 16%; physicians, 17%; pharmacists, 13%)

consultation with clinical experts from other EDs as a source of knowledge to guide practice. In addition to personal sources from their own department, participants also report reliance on clinical practice guidelines to guide practice (93/105 or 89%). Use of knowledge from both research evidence (79/105 or 75%) and clinical experience (94/105 or 89%) to guide practice is also an expectation in most EDs.

Table 4. Descriptive Statistics of Survey Items Study I

Item	Dimension	Agree/Strongly Agree (N=105) N (%)	Mean	Mode
I have adequate access to a library in my health center.	Context	56 (53)	2.56	3
I have adequate access to a librarian to assist me with finding information related to emergency practice.	Context	42 (40)	2.18	1
I have adequate access to paper journals in emergency care in my health centre.	Context	57 (54)	2.50	3
Staff in our ED rely on clinical practice guidelines and protocols to guide practice.	Context	93 (89)	3.07	3
In our ED, we are expected to use research evidence to guide our practice.	Context	79 (75)	2.82	3
In our ED, we are expected to use clinical evidence to guide our practice.	Context	94 (89)	3.02	3
Our ED is actively involved in research related to Emergency practice.	Context	48 (45)	2.49	2
Over the past two years I have had adequate access to continuing education opportunities (other than this web based study) related to pediatric emergency care.	Context	54 (51)	2.47	3
My team meets on a regular basis (at least monthly) to discuss new research and/or proposed changes to clinical practice in our ED.	Context	31 (29)	2.15	2
I rely on nurses from my emergency department (ED) as a source of knowledge about pediatric emergency care.	Individual	72 (69)	2.87	3
I rely on physicians from my ED as a source of knowledge about pediatric emergency care.	Individual	97 (92)	3.16	3
I rely on pharmacists from my health center as a source of knowledge about pediatric emergency care.	Individual	33 (31)	2.18	2
I rely on the Nurse Manager in my ED as a source of knowledge about pediatric emergency care.	Individual	28 (27)	2.10	2

Item	Dimension	Agree/Strongly Agree (N=105) N (%)	Mean	Mode
I rely on the Medical Director/Senior Physician of my ED as a source of knowledge about pediatric emergency care.	Individual	59 (62)	2.58	3
I consult with physicians from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	Individual	18 (17)	1.85	2
I consult with nurses from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	Individual	(17) 16	1.82	2
I consult with pharmacists from other health care organization on medication issues related to pediatric emergency care.	Individual	(14) 13	1.76	2
I use paper journals on a regular basis (at least monthly) to address questions I have related to patient care.	Individual	39 (37)	2.28	2
I am actively involved in research related to emergency practice.	Individual	34 (32)	2.26	2
I use bibliographic databases (Pubmed, Medline, CINAHL or Cochrane Library) on a regular basis (at least monthly) to find literature to address questions I have related to pediatric emergency care.	Knowledge	23 (22)	2.06	2
I have adequate access to a computer with an Internet connection in my clinical area.	Knowledge	78 (74)	2.90	3
I use online journals on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	Knowledge	32 (30)	2.17	2
I have adequate access to online journals in emergency care in my health centre.	Knowledge	68 (65)	2.63	3

(1=strongly disagree , 4 = Strongly agree)

Factory Analysis

The 23 items on the questionnaire were subjected to an exploratory factor analysis using principal components analysis (PCA) to determine the number of common factors influencing the measure and the strength of the relationship between the factors and the measure. Inspection of the pattern of the correlation matrix revealed items correlate fairly well with significance level below .05 for the majority of correlations for each variable. Inspection of the anti-image correlation matrix revealed

all items were above the acceptable .5 Kaiser-Meyer-Olkin (KMO) value and the overall KMO statistic was acceptable at .720 (Field, 2005). Bartlett's test of Sphericity was significant ($p < .001$) supporting the factorability of the correlation matrix. The initial run of the PCA with eigenvalues set at 1.0 produced a 7-factor solution which accounted for 69.7% of the variance (Table 5). Items in Factor 1 (items 1,2,3,4,8,9,15,16) account for the greatest amount of variance and are primarily related accessible explicit knowledge sources except for items 8 and 9, which relate to leadership support. Items in Factor 2 (items 10, 11, 12) centre around knowledge exchange with colleagues in other departments and items in Factor 3 (items 5,6,7,9) are centre around knowledge exchange with colleagues in their own ED. Items in Factor 4 (items 2, 14, 17, 18) and Factor 5 (items 16, 19, 20) reflect structures in the ED that contribute to the development of a research and knowledge generation infrastructure. Items in Factor 6 (items 21,22,23) reflect the different sources of knowledge that are used to guide clinical practice. Items in Factor 7 (items 13,14) are similar to Factor 1 with a focus on explicit knowledge sources in the form of journals.

Table 5. Exploratory Factor Analysis.

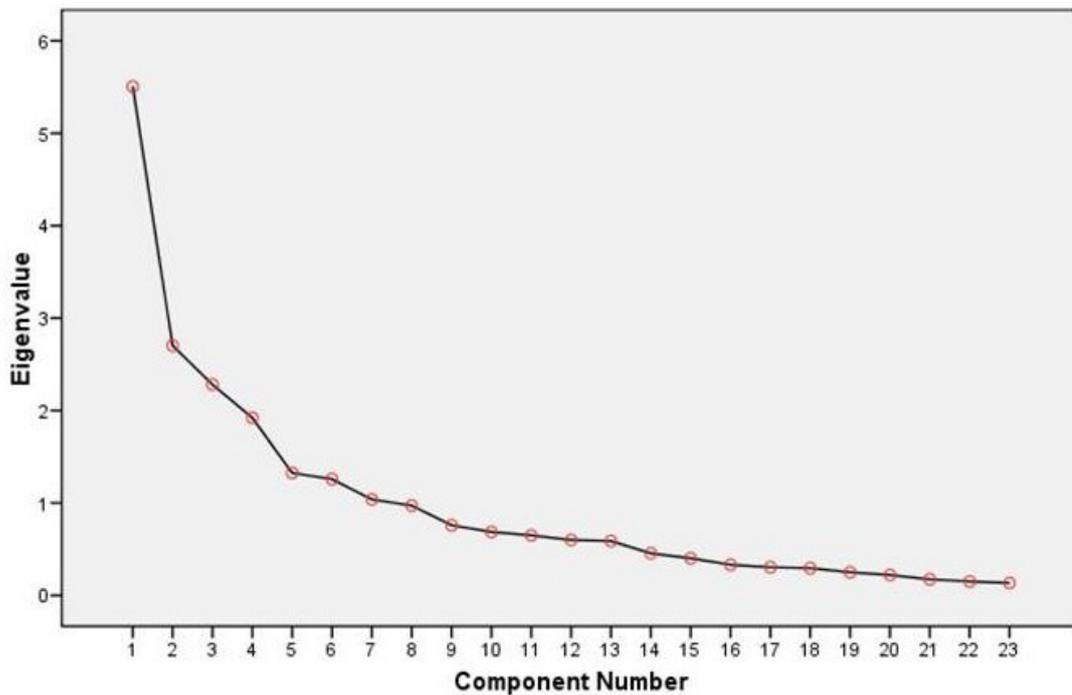
Factors	Component						
	1	2	3	4	5	6	7
1.I have adequate library access	.669						
2.I have adequate librarian access	.586			.515			
3.I have adequate access to online journals in my health centre	.673						
4.I have adequate paper journal access in my health centre	.742						
5.I rely on nurses from my ED for pediatric emerg care info			.775				
6. I rely on physicians from my ED for pediatric emerg care info			.792				
7. I rely on pharmacists from my health centre for info			.517				
8. I rely on my ED nurse manager for info	.558						
9. I rely on my medical director/senior physician for info	.485		.522				
10. I consult physicians from other EDs		.862					
11. I consult nurses from other EDs		.872					
12. I consult pharmacists from other health centers		.849					
13.I consult paper journals every month							.847
14. I consult online journals every month				.510			.514

Factors	Component						
	1	2	3	4	5	6	7
15. I consult bibliographic databases every month	.495						
16. I have adequate internet access in ED clinical area	.440				.524		
17. My ED is involved in research				.731			
18. I am personally involved in ED research				.851			
19. Access to adequate continuing ED opportunities					.632		
20. My team meets monthly re new research/clinical practice					.822		
21. Our ED uses research evidence to guide practice						.696	
22. Our ED uses clinical evidence to guide practice						.788	
23. Staff in our ED rely on clinical practice guidelines/protocols to guide practice						.587	
Explained Variance	23.94%	11.75	9.17	8.35	5.75	5.47	4.51

(note: loadings < .4 not represented)

Examination of the point of inflexion on the Scree Plot (Figure 2) from this PCA would suggest that a 4 factor solution might also fit the data.

Figure 2. Scree Plot for First Run Factor Analysis



However, initial conceptualization of the model based on the literature and experiential knowledge included 3 dimensions (individual factors, practice context factors and knowledge factors), therefore 3 factors were retained and rotated using varimax rotation. The three factor solution explained 46% of the total variance. All items except item 4 and 23 demonstrated moderate to strong loadings ($>.40$) on one of the three factors (Table 6). Items in Factor 1 explained 23.9 % of the variance (items 1,2,3,8,14,15,16,17,18,19,21,22) ($\alpha = .855$) and were primarily concerned with resources in the practice setting and resource use. Items in Factor 2 explained 11.75% of the variance (items 10,11,12,13) ($\alpha = .768$) and were primarily concerned with the use of knowledge resources external to their practice setting and other than the item on paper journals included people resources. Items in Factor 3 explained 9.91 % of the variance (items 5,6,7,8,20) ($\alpha = .655$) and were primarily concerned with individuals preferred knowledge sources within their practice setting. Sources were primarily people sources except for item 20 which referred to use of clinical practice guidelines.

Table 6. Factor Analysis (PCA) with 3 component solution

Factor	Component		
	1	2	3
1. I have adequate library access in my health centre	.698		
2. I have adequate librarian access to assist with finding information	.763		
3. I have adequate access to online journals in my health centre	.712		
8. I rely on ED nurse manager as a source of knowledge	.426		
14. I use online journals every month to address clinical questions	.621	.418	
15. I use bibliographic databases every month to address clinical questions	.645		
16. I have adequate internet access in ED clinical area	.587		
17. Our ED is involved in emergency practice research	.547		
18. I am actively involved in emergency practice research	.444		
19. I have adequate continuing education opportunities	.674		
21. My team meets monthly to review new research/clinical practice	.565		
22. In our ED we are expected to use research evidence to guide practice	.493		
23. In our ED we are expected to use clinical evidence to guide practice			
4. I have adequate access to paper journals in health centre			
10. I consult with physicians from other EDs to address clinical questions		.854	
11. I consult with nurses from other EDs to address clinical questions		.864	
12. I consult with pharmacists from other health centers to address clinical questions		.732	

Factor	Component		
	1	2	3
13. I use paper journals every month to address clinical questions		.555	
5.I rely on nurses from my ED as a source of knowledge for pediatric emergency care			.783
6.I rely on physicians from my ED as a source of knowledge for pediatric emergency care info			.761
7.I rely on pharmacists from my ED as a source of knowledge for pediatric emergency care			.444
8.I rely on the medical director/senior physician in my ED as a source of knowledge for pediatric emergency care			.606
20.Staff in our ED rely on clinical practice guidelines/protocols to guide practice			.500
Explained Variance	23.94	11.75	9.91
Cronbach's α	$\alpha =$.855	$\alpha =$.768	$\alpha =$.655

(note: loadings < .4 not represented)

Participation in this web based knowledge exchange intervention did not appear to be influenced by any of the items in the knowledge dimension as conceptualized at the outset of the project. However, there was a relationship between participation in the knowledge exchange intervention and two items in the individual dimension (I consult with nurses outside of my ED, I am actively involved in research) and one item from the context dimension (In our ED we are expected to use research to guide practice) (Table 7).

Table 7. Relationship between survey items and participation in Web innovation

Item	Dimension	Agree/ Strongly Agree		Mode		X ²	P value
		Participate		Participate			
		Yes (N=45)	No (N=60)	Yes	No		
I consult with nurses from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.	Individual	12	5	2	1	6.369	.012
I am actively involved in research related to emergency practice.	Individual	20	14	2	2	5.234	.019
In our ED, we are expected to use research evidence to guide our practice.	Context	39	40	3	3	5.521	.015

A comparison of rural and urban clinicians' use of preferred and expected knowledge sources to guide practice reveals that clinicians are generally similar with the exception of the use of research to guide practice and reliance on physicians as a source of clinical practice knowledge (Table 8). A significantly larger percentage of urban clinicians indicated that they use research evidence to guide practice and they rely on physicians in their own ED to guide practice.

Table 8. Comparison of Rural and Urban preferred knowledge sources

Knowledge Source	Rural (N=59)		Urban (N=46)		Z score
	% Agree/ Strongly agree	Mode	% Agree/ strongly agree	Mode	
In our ED we are expected to use research evidence to guide practice	64% (38)	3	89% (41)	3	-3.796**
In our ED we are expected to use clinical evidence to guide practice	90% (53)	3	89% (41)	3	-1.934
Staff in our ED rely on Clinical practice guidelines to guide practice	88% (52)	3	89% (41)	3	-.691
I consult paper journals to address practice questions	39% (23)	2	35% (16)	2	-.160
I consult online journals to address practice questions	27% (16)	2	35% (16)	2	-1.308
I consult bibliographic databases to find literature to answer clinical questions	22% (13)	2	22% (10)	2	-.318
I rely on nurses from my own ED as a source of knowledge	65% (38)	3	74% (34)	3	-1.534
I rely on physicians from my own ED as a source of knowledge	90% (53)	3	96%(44)	3	-2.033*
I consult nurses from other EDs as a source of knowledge	19% (11)	2	13% (6)	2	-.313
I consult physicians from other EDs as a source of knowledge	19% (11)	2	15% (7)	2	-.341

* $p < .05$

** $p < .001$

Logistic regression analysis was planned to determine which variables (survey score, discipline, setting, age, advanced certificate training, years of experience in ED) best predicted participation in the web based knowledge exchange intervention, however sample size was insufficient to generate meaningful results.

Discussion

Individual, practice context and knowledge factors impacting participation

Overall less than half (43%) of the survey respondents participated in the web based knowledge exchange intervention which was intended to link clinicians from rural and urban EDs. Review of the survey items representing the individual and knowledge dimensions of the **Model for Knowledge Exchange and Utilization in Emergency Practice** would suggest that survey respondents rely heavily on peers (nurses 69% and physicians 92%) from their own ED for knowledge to guide their practice and are less inclined to use people sources from other EDs or explicit sources such as paper journals or online journals. These results are similar to study findings from other practice settings (Gerrish & Clayton, 2004; Estabooks et al 2005; Bennett et al., 2006).

Geographical boundaries have been shown to influence the social networks of nurses and physicians (West & Barron, 2005). The web based knowledge exchange intervention in this project was intended to breakdown geographical boundaries and provide participants with an opportunity to engage in discussion with clinicians from outside of their own ED. In an earlier paper comparing clinicians online and offline knowledge exchange behaviors, a social network analysis revealed a significantly higher number of knowledge exchange opportunities in the online environment (Curran & Abidi, 2007). Use of personal knowledge sources from other EDs (individual dimension) was found to be significantly related to participation in the web based knowledge exchange intervention ($\chi^2 = 6.369$, $p = .01$). A greater percentage of respondents who participated in the project reported use of external personal sources. Linkages between EDs are important for the exchange of new knowledge. Granovetter (1983) in his work on the Strength of Weak Ties highlights the importance of weak ties in spreading new ideas and scientific information.

Although most weak ties serve no function, he suggests that members of a densely knit network share similar information and perspectives and it is the presence of weak ties which bridge different densely knit networks that allow novel ideas and new information to be introduced. Nelson's (1989) work also supports the notion that people use weak ties to transmit novel information or for diffusion of innovation. Although the model was useful in highlighting the relationship between use of personal knowledge sources from other EDs (individual dimension) and participation in the web based, the direction of the relationship remains unclear.

Two other factors that were found to be significantly related to participation in the intervention were personal involvement in research activities (individual dimension) ($\chi^2 = 5.234$, $p = .019$) and perception of organizational expectation to use research evidence to guide practice (context dimension) ($\chi^2 = 5.521$, $p = .015$). Participation in research activities has been associated with research use in practice (Bostrom & Suter, 1993; McCleary & Brown, 2003). Less than half of survey respondents indicated they were personally involved in research or that their ED was involved in research. It is possible that a lack of exposure to or experience with research initiatives may have contributed to the moderate participation rate in this intervention. This web based knowledge exchange intervention provided clinicians with exposure to best practice knowledge through emergency practice content specific learning modules. Clinicians have demonstrated a willingness to use online evidence at the point of care to fill in gaps in their practice knowledge; however, adequate training and supportive leadership were important factors (Prendiville, Saunders, & Fitzsimons, 2009; Gosling & Westbrook, 2004). Overt strategic initiatives and support from management are necessary to permeate the boundaries that inhibit the development of social relationships and consequently knowledge sharing between communities (Cross et al., 2005). Participant's perception regarding their organizations expectations around the use of research evidence to guide practice may have decreased their interest in the best practice knowledge presented in the intervention.

Practitioner's perceptions of organizational expectations regarding use of knowledge

Organizational context has been identified as an important factor in knowledge exchange and best practice (Kitson et al 1998; Brown & Duguid, 2001; Gerrish & Clayton, 2004). Overall 75% of survey respondents reported that they were expected to use knowledge from a variety of sources (clinical practice guidelines, research evidence, and clinical evidence) to guide their practice. Yet, only 37% report using paper journals, 30% report using online journals and 22% report using bibliographic databases on a regular basis. In addition, only 43% chose to participate in a knowledge exchange intervention which presented best practice knowledge relevant to rural and urban emergency practice settings.

There was a significant difference between rural and urban clinician's perceptions of organizational expectations regarding use of research evidence to guide practice. This difference may be due to the lower volume of research activities in rural settings. Practice contexts that embody characteristics of a learning organization have been identified as important in the literature on knowledge exchange in health care environments (Davis et al 2000; Chunharas, 2006). Activities such as journal clubs, regular team meetings or an active program of research create opportunities to discuss knowledge in the context of local practice and are reflective of a practice culture that values knowledge. Organizations need to make an overt, visible commitment to demonstrate their value for knowledge exchange. According to survey participants, structures to support seeking and sharing of explicit or external knowledge sources were limited. Only 29% of respondents indicated opportunities to participate in discussion about new research or proposed practice change in their ED and 60% felt that did not have adequate access to a librarian to assist with finding new information related to their practice. Less than half (45%) of survey respondents indicated that their ED was actively involved in research. Clinicians recognize the importance of best evidence to guide practice however, a lack of organizational infrastructure and resources to support knowledge sharing activities may influence clinicians' willingness to engage in a knowledge exchange intervention.

Preferred knowledge sources of rural and urban practitioners

Published studies exploring the information needs of health professionals suggest that rural health practitioners have the same patient-care information needs as their urban counterparts (Dorsch, 2000). In general, rural and urban participants in this study presented a similar preference pattern for knowledge resources. Although external colleague sources were the least likely to be used, internal colleague sources, particularly physician sources, from their own ED were the most highly used resource. Explicit sources in the form of bibliographic data bases and paper and online journals were used minimally in both settings and clinical practice guidelines were identified as a valuable explicit source for both groups. This pattern is similar to other studies exploring knowledge sources of rural and urban clinicians (Gorman et al 2004), that is, colleague sources are more highly valued than explicit, text based sources. However, this study contributes new information regarding personal knowledge sources of rural and urban EDs. We know that smaller rural centers have limited expert personal sources of knowledge (Canadian Association of Emergency Physicians, 2002). In many smaller EDs family practice clinicians, with little or no formal emergency specialty training, provide medical coverage for emergency services and may not actually be onsite 24hrs. This may account for the significant difference ($p < .05$; $z = -2.033$) between the two groups in their reliance on physicians as a source of knowledge. In addition results from this study reveal that use of external personal sources of knowledge to guide practice is limited. This suggests the flow of new knowledge between EDs maybe limited and presents an important knowledge exchange gap for under-resourced, smaller EDs. The web based knowledge sharing intervention in this study was intended to bridge geographically dispersed EDs and connect smaller communities of practice for knowledge exchange. There is a need to identify strategies to enhance use of this resource.

A significantly greater ($p < .001$; $Z = -3.796$) number of urban clinicians reported use of research evidence to guide practice than their rural counterparts difference. This is an interesting finding considering both groups have similar patterns in their use of explicit knowledge sources. However, the difference may be attributed to the significantly higher volume of research activities reported in the urban centres ($P < .001$; $Z = -6.276$) versus the rural centers. This finding would support the notion that participation in research activities is associated with research use in practice (McCleary & Brown, 2003).

Limitations of this study

Results from this study may be limited by the small sample size and the inadequate number of physician respondents. Factor analysis is dependent on sample size as correlation coefficients are particularly vulnerable to fluctuation in smaller sample sizes. Conclusions for this factor analysis are restricted to the current study and cannot be generalized unless analysis using different and larger samples reveals a similar structure. It should also be noted that multiple comparison adjustments were not made during data analysis which may have influenced study results. However, it has been argued that adjustments are not necessary when there is a strong basis for expecting a difference in groups (Rothman, 1990). Differences in the resource availability of rural and urban settings are well documented in the emergency practice literature therefore there was a prior expectation for finding a difference in resource use. Although the scale produced a good reliability measure it will benefit from further testing with a larger sample size and adjustment for multiple comparison.

Conclusion

Understanding clinician's participation in this innovative web based knowledge exchange intervention is important for identifying potential barriers and facilitators for future studies. Individual factors (beliefs and attitudes) and organizational factors (facilitating conditions) have been identified as important in continued knowledge seeking and sharing in electronic networks outside of health care (He et al., 2009). The purpose of this study was to evaluate the utility of the Model for Knowledge Exchange and Utilization in Emergency Practice for explaining emergency clinician's participation in the intervention. The model was used to develop a 23 item self-report survey representing 3 dimensions; individual, context of practice and knowledge. The reliability of the total scale was strong; however, factor analysis did not support the dimensions as originally proposed. Isolating distinct dimensions through factor analysis may be unrealistic as there may be significant overlap or interdependency between dimensions in the knowledge exchange phenomena. However, the model was useful in identifying factors which might help explain participation in the intervention. Participation in the web based knowledge exchange intervention was

related to consultation with nurses from other EDs (individual dimension), personal involvement in research activities (individual dimension) and expectation for the use of research evidence to guide clinical practice (practice context dimension). Although the majority of respondents identified organizational expectations to use multiple types of knowledge (clinical practice guidelines, research evidence, and clinical evidence) to guide practice there was a difference in rural and urban clinician's perception regarding use of research evidence. Rural and urban participants in this study presented a similar preference pattern for knowledge resources. External personal sources were the least likely to be used and personal sources, particularly physician sources, from their own ED were the most highly used resource. Explicit sources in the form of bibliographic data bases and paper and online journals were used minimally in both settings. The **Model for Knowledge Exchange and Utilization in Emergency Practice** provided a practical framework for development of an evaluation survey for the *Multidisciplinary Pediatric Emergency Care Web Based Learning Project*. Results from this survey may provide useful information for emergency practice researchers and administrators interested in facilitating web based knowledge exchange within and between rural and urban emergency practice settings.

Study II

Introduction

The **Model for Knowledge Exchange and Utilization in Emergency Practice** was developed from a multidisciplinary perspective for application in rural and urban practice settings. Study I was inclusive of nurses and physicians from rural and urban practice settings. However, unique barriers and facilitators may exist across different practice settings and disciplines (Grol & Grimshaw, 2003). Examining the model from a unique perspective should assist in identifying possible gaps as well as the potential utility across exceptional circumstances. Therefore, Study II challenged the model from a more focused perspective. This qualitative project focused on knowledge exchange and utilization by the professional discipline of nursing in an urban emergency department. An urban setting was chosen because of the unique challenges larger centres face with patient acuity and flow. Nursing was chosen

because they form the largest professional group in the ED. An ethnographic method was used to describe the culture – the customs, beliefs and behaviour - of emergency nurses' knowledge exchange activities. "Ethnographic research is predicated on the day to day involvement of the researchers in the everyday life of a setting or a group of people." (Pope, Smith, Goodwin, & Mort, 2003). Ethnography involves being up-close and personal with the group under study and generally includes a variety of data sources and collection methods (Genzuk, 2003). The **Model for Knowledge Exchange and Utilization in Emergency Practice** was used as a guiding framework for data collection and analysis with the understanding that the model would likely transform as the research data from the fieldwork was explored. In an effort to tap into the underlying customs, beliefs and behaviours of nurses regarding knowledge exchange and utilization, the following knowledge oriented questions were used as a starting point for observations and interviews:

1. How do nurses typically seek and share knowledge in a pediatric emergency department?
2. What types of knowledge do nurses require for practice in an emergency practice setting?
3. How do emergency nurses use knowledge in practice?
4. What are the common knowledge sources used by nurses in a pediatric emergency practice settings.
5. What do nurses perceive as barriers and facilitators for knowledge exchange and use in a pediatric emergency department?

Method

Data was collected using participant observation sessions, key informant interviews and review of relevant department documentation (clinical policy manuals, census data reports, orientation documents). A maximum variation sampling strategy (Patton, 2002) was used to ensure capture of the core experiences and central dimensions of knowledge exchange and utilization for nurses in the emergency department.

According to Benner (1984), the level of experiential or clinical knowledge of a nurse may influence how and what type of knowledge is used in practice. This in turn is

likely to impact knowledge seeking and sharing behaviours, therefore purposive sampling was used to identify participants across a range of clinical experience for inclusion in the study. The Clinical Leader from the emergency department was asked to supply a staff list indicating the years of service for each nurse in the emergency department according to one of three categories of experience: Novice (less than a year ED experience), Competent (1 to 5 years ED experience) and Expert (greater than 5 years ED experience). A letter was then sent to each member of the nursing staff through the health centre internal mail to inform them about the study and to invite them to participate. The study was approved by the Research Ethics Board and all participants were asked to sign a separate consent form for the participant observation (Appendix B) and the interview (Appendix C).

Participant observations were used to gather information about the characteristics and conditions of knowledge seeking and sharing behaviour, including verbal and non-verbal communication, and specific clinical and environmental conditions. Participant observations involved observing nurses while they were providing care to patients and families and interacting with their interdisciplinary colleagues. Observation times were organized with the assistance of the Clinical Leader. Observations took place during a variety of times to reflect the activities carried out on day, evening and night shifts on all seven days of the week. Observations were scheduled during a variety of times to observe change of shift, break coverage and other unit routines. Ten observations (4 Novice, 3 Competent, 3 Expert) took place over a period of 11 months. Each observation was 2 – 3 hours in duration. Observation data were recorded by hand on data collection forms which included the following column headings to guide observations: knowledge exchange event (seeking/sharing), knowledge source (nurse, physician, text, policy etc), Type of activity (face to face, phone, computer, etc), time length of interaction and additional comments. Field notes were also written by hand on a separate note pad during the period of observations and expanded using a laptop during breaks or at the end of the day while the details were fresh. Field notes not only reflected the observations of the researcher but the feelings and interpretations of what she saw and experienced. The researcher kept a journal of her own experiences, theoretical ideas and analytical insights throughout the data collection process. This journal was kept separate from the field notes and also contributed to analysis and interpretation of findings.

In-depth interviews were conducted with key nursing informants from the observation sessions. Potential interview participants were identified through the initial observation consent process. Interviews were conducted at the convenience of the nurse and the emergency department and took place in a quiet space near the clinical area. Interviews elicited the details about the nurses' knowledge exchange and utilization practices and lasted approximately 1 to 1.5 hours. Semi-structured interviews with open ended questioning style were employed (Appendix D). A topic list was developed from the dimensions (individual, context of practice, knowledge) in the Model for Knowledge Exchange and Utilization in Emergency Practice and categories identified from initial analysis of the participant observation. Questions about incidents and activities noted during the field observations were posed in order to verify interpretations by the researcher. A total of 7 (3 Novice, 2 Competent, 2 Expert) interviews were conducted. All interviews were audiotaped and transcribed. Data collection generated a large volume of data (380 pages of field notes, observation data collection tables, interview transcripts). Participant observations and related interviews were stored in separate file folders.

In keeping with ethnographic methodology (Schmoll, 1987), data analysis began after the first participant observation experience. Analysis was guided by the constant comparison method as outlined by Glaser and Strauss (1967). All recorded data were subjected to the following steps 1. Categorizing of data bits 2. Comparison with previous collected data 3. Refinement of the categories. The **Model for Knowledge Exchange and Utilization in Emergency Practice**, which was derived from a review of the literature and the experiential knowledge of author, was used to set up general orienting categories. This placed limits on the inductiveness of the process but allowed the analysis to benefit from and build on previous conceptual work. Data were organized in an evolving matrix table of categories, subcategories and seminal quotes that was refined in an ongoing process during data collection and analysis.

Regardless of the research method, rigor is a fundamental element for ensuring the quality of a project. Although it has been argued that the quality of a research study can not be assured by the rigorous application of strategies and procedures but is actually revealed in the writing-up of the project and the research report (Rolfe,

2006), others advocate for the use of a framework to ensure rigour in qualitative projects (Shenton, 2004). Specific strategies have been identified by Lincoln and Guba (1985) to attain trustworthiness (rigor) in qualitative projects. These strategies must be woven throughout all stages of the research process (Morse et al, 2002). Trustworthiness of the data in this study was evaluated by attending to the following criteria; *credibility, transferability, dependability and confirmability* (Lincoln and Guba, 1985). To ensure the findings reflected the reality of the participants (credibility) the following procedures were employed: persistent observation, prolonged engagement, member checking, tactics to help ensure honesty, examination of previous research findings, peer scrutiny and triangulation. Participant observations and interviews were carried out over a 14 month period on a variety of shift times. This allowed the researcher to sample knowledge exchange and utilization behaviour under a variety of conditions. The researcher was familiar with the culture of this emergency department having worked as an educator with this team for several years prior to data collection and had established a relationship of trust with the staff. After completion of the second participant observation the researcher invited a member of the emergency department team to review the observation notes and the initial categories. This activity, in addition to the use of probing questions in the follow up interviews, provided an opportunity to check how closely the researchers' interpretations of the data reflected the participants' experiences. A peer review group comprised of 3 nurses (1 educator from the ED, 1 Advanced Practice Nurse, and 1 nurse with 11 years of ED experience who no longer worked in the department) was established at the outset of study. This group was familiar with the study protocol and met with the researcher at regular intervals (after every 3 observation sessions) to review all transcripts and discuss coding categories. Member checking in this manner allowed the researcher to progress forward with confidence in the coding strategy. A variety of strategies were employed to help ensure honesty in informants. Each participant was given the opportunity to refuse to participate in the project. They were assured that there was no right or wrong answers during the interviews and encouraged to contribute ideas and talk about their experiences. Participants were also assured that all names and descriptors which could identify individuals would be removed from observation and interview transcripts. This allowed for confidential sharing of knowledge exchange experiences. Finally, triangulating multiple sources (participant observations, key informant interviews, policy and census documents) of

data from a range (novice, competent, expert) of participants presented an opportunity to verify individual viewpoints and experiences against others and contributed to the description of a rich picture of nurses attitudes, beliefs, views and behaviours about knowledge exchange and utilization in emergency departments. The constant comparison method not only included comparison of observation and interview data but also included the **Model for Knowledge Exchange and Utilization in Emergency Practice**. This ensured comparison of findings with relevant research literature.

Transferability (a form of external validity) was accomplished through the detailed description of the emergency department and the context of practice. In addition, the number and experience level of the nurse participants as well as the data collection methods have been presented. This level of detail should allow the reader to decide whether the environment is similar to another situation or setting. Many of the procedures that contribute to credibility can also help to ensure dependability. Nevertheless, detailed description of the research design, data gathering procedures, and analysis will allow the reader to develop a thorough understanding of the methods and their effectiveness and then determine the extent to which proper practices have been followed. In addition to the triangulation of methods, confirmability was sought through the establishment of an audit trail. All versions of the data matrix have been stored to allow any observer to trace the various stages of analysis. Access is available through the PI.

Data Presentation

The Setting:

The pediatric emergency department in this study is situated in an urban tertiary care children's teaching hospital. The department provides 24 hour medical/surgical emergency care to infants, children and youth up to their sixteenth birthday and emergency mental health services to children and youth up to 18 years plus 364 days. The annual patient census is 27,105 with an average daily census of 74 patients. Fever of unknown origin, acute upper respiratory infection and asthma are the top 3 diagnosis in the department (Table 9). Children between 3 months to 2 years make more visits to this ED each year than any other age group.

Table 9. Top 3 Diagnosis by Triage level and Age Category 2007-2008

Diagnosis	Acuity Level - Census	Age Grouping	Census by Age
Fever of unknown origin	I - 4 II - 124 III - 334 IV - 1,088 V - 2	Less than 1 month	15
		1 to 2 months	58
		3 months to 2 years	841
		3 - 5 years	378
		6 - 11 years	219
		12 - 15 years	32
		16 - 18 years	9
Acute upper respiratory infection	II - 38 III - 217 IV - 1,270 V - 8	Less than 1 month	15
		1 to 2 months	87
		3 months to 2 years	888
		3 - 5 years	319
		6 - 11 years	183
		12 - 15 years	39
		16 - 18 years	1
Asthma	I - 29 II - 297 III - 432 IV - 304 V - 1	Less than 1 month	0
		1 to 2 months	0
		3 months to 2 years	351
		3 - 5 years	326
		6 - 11 years	304
		12 - 15 years	81
		16 - 18 years	0
		Over 19 years	0

The waiting room is at the front of the emergency department and the passage way into the patient treatment area is flanked by the triage nurse on one side and staff from protection services on the other. The department has a 14 bed capacity with 2 additional observation unit beds for patients who may require an extended period (up to 12 hours) of observation in the department before discharge. Included in the 14 beds is a two bed trauma room, 3 isolation rooms, and 1 orthopaedic procedure room where a patient would be placed if they required cast application or closed reduction of a fracture. The patient beds/rooms are arranged in a horseshoe around the nursing station which is enclosed on three sides by a floor to ceiling wall. The top half of the wall is constructed out of plexi-glass to allow visualization of the entire department. In the centre of the nursing station is a waist high blue desk measuring four feet high by six feet wide. This blue desk is the central hub of the department. All information flows through and around this area. On one of the side walls of the nursing station

there is a large dry erase white board which contains information about patients who have been placed in the department. The ward clerk sits inside the nursing station at the outer perimeter of the front wall (without the plexi-glass) facing out toward the waiting room and with her back to the blue desk. At the back of the nursing station is a lower counter that runs the full length of the back wall with two computer stations.

In general, patient flow in the department is as follows 1. triage for assessment by a nurse and assignment of acuity level based on the 5 level Canadian Pediatric Emergency triage and Acuity Scale (CTAS) (Warren et al., 2008) 2. Registration clerk 3. placement in the waiting room until bed and staff are available in the emergency department 4. placement in a treatment room in the ED for assessment by physician and intervention 5. discharge. Timing of patient progression through this sequence is dependent upon a number of factors including acuity level of the patient, volume and acuity of other patients in the emergency department, and medical/nursing staff compliment. The CTAS guidelines were developed by a national working group to standardize triage in Canadian emergency departments and are applicable in both rural and urban settings. The CTAS guidelines attempt to define patient needs for timely care using the following levels: Level 1: Resuscitative; Level 2: Emergent; Level3: Urgent; Level 4: Less Urgent; Level 5: Non-urgent. (Warren et al., 2008)

The total clinical nursing staff compliment in this department includes 11 full time and 23 part-time nurses. In addition to the clinical nursing staff complement the emergency department is also supported by one nurse Clinical Leader whose role is primarily administrative and one nurse research coordinator whose role is to coordinate research in the department. On average there are 4-6 nurses on day shifts, 6-7 nurses on evening shifts and 4 nurses on night shifts. Nursing staff assignments per shift are as follows: one nurse is assigned to triage (where patients are assessed and potentially reassessed for level of acuity), one nurse is assigned to charge duties (this person manages the overall flow of the department, picks up patient care duties for other nurses who are busy, at lunch or coffee break, or overwhelmed with a complex, sick patient), the remaining nurses on the shift are responsible for moving the patients from the waiting room into the emergency department based on the patient's arrival time, the CTAS level assigned to the patient by the triage nurse, and

the availability of a bed and staff to care for the patient. The nurse who places the patient in the department generally follows the patient through to discharge. When patients are first placed in their assigned bed their weight and height are measured, they are asked to change into hospital pyjamas, and the nurse conducts a focused assessment based the patients presenting complaint. The nurse then brings the patient chart to the nursing station, writes her assessment note and relays the information to the emergency room physician (ERP) on duty. The medical staff compliment is comprised of 8 full-time and 13 part-time physicians. In general there is one physician working during each shift with double coverage (2 physicians) between the hours of 1600 to 2400.

Major Themes:

Using a constant comparative method and moving between observation transcripts, field notes, interview transcripts, administrative data and the Model for Knowledge Exchange and Utilization in Emergency Practice the following core themes surfaced; 1. Knowledge as a valued resource 2. Different types of knowledge needs 3. Knowledge exchange behaviours and 4. Barriers for seeking and sharing.

Knowledge as a valued resource

“I found myself listening to Dr A. teach this morning, like I found listening to her talk about fever in a child under three months old and how you would manage, and the antibiotics, and the bacteria, the main sources of infection in this age group and everything like that, I learned so much by just sitting there and listening” [interview_novice_08]. Knowledge as a valued resource appears to be embedded in the culture of this department. Situated in a teaching hospital, nursing students, as well as pediatric and emergency interns and residents rotate through this department on a regular basis. The medical staff conduct the majority of their case based teaching and discussion with medical interns and residents at the “blue desk” [observation notes_competent_05; observations notes_novice_08; observation notes_competent_06]. The central location of this desk makes this exchange accessible to the nursing staff sitting on the opposite side of the desk. “Dr. X teaching medical student by desk. Excellent example of encouraging learning by discover” [observation notes_completent_05]. The interns and residents are often asked to think

'outloud' about what they had observed during their patient assessments and to offer suggestions and rationale for treatment.

“The majority of the 2 hour period while I was there, 03 was sharing information with the student nurse. Every procedure was explained. Every patient she placed they talked about the etiology of the presenting complaint, usual progression of illness” [observation notes_novice_03]. Nurses in this department are also responsible for mentoring nursing students from the provincial baccalaureate programs [observation notes_novice_03]. The knowledge exchange events that I observed between nurse preceptors and nursing students were comprehensive although less publically available to other members on the team than the physician knowledge exchange events. Discussions tended to be one-on-one and quieter, therefore less available to others in the department. The nurse preceptor shared knowledge about disease etiology, usual progression of illness, medical procedures and common medications as they moved between the patient and the blue desk or the procedure room or the medication room

“you tend to discuss things with staff I guess, to validate your reasoning why, you know, to see if you are on the same wavelength with other people” [interview_expert_01]. Nurses value knowledge from their peers to validate their practice.

“When you are doing conscious sedation the doctors are like “how much should I give them?” and you know I always figure it out before hand so I know myself and I will say “it’s usually the dose that’s on the paper [guideline] between this and this” and I’ll let them make the decision on what to give.....but I’ll guide them...I feel you always have to have the knowledge so that they’re not making mistakes [interview_Novice_03]” Nurses not only value knowledge to guide their own practice but will also advocate on behalf of their patients to ensure that other disciplines use knowledge in practice. In the previous quote a novice nurse is speaking about an experience she had with an orthopedic resident who had come to the emergency department to perform a closed reduction on a child with a fracture.

“Some doctors are like, get ‘em in, and get ‘em out [patient flow].....and you know, parents come to emerg looking for answers and they may just accept anything that the doctors tell them without realizing that there are other options out there or other questions they can ask...but I think it is important for us to touch base with parents to make sure that they know what’s going on and keep them updated” [interview_novice_03]. Nurses also value the importance of knowledge in supporting families. I observed numerous examples of nurses speaking with parents on the phone or face-to-face in the department; sharing the knowledge needed for parents to feel comfortable caring for their child at home [observation_expert_02]. This was also an important knowledge sharing activity identified in several interviews.

Along the walls in the halls of this department are posters that have been presented at various conferences by members of the medical and nursing staff. A glass display case mounted on the wall just outside of the department is filled with journal publications authored by nursing and medical staff from the emergency department. This department is the only clinical department in the health centre to have a full time research coordinator position; which is currently occupied by a nurse. A number of committees, including a Research Committee and an Education Committee, are organized and managed by nurses in the department with resource support from the leadership team. The dedicated resources (space, time and funding) to facilitate knowledge sharing, highlight the academic achievements of staff and build a program of research are visible demonstrations of how different types of knowledge are valued by this department and the leadership team.

Different types of knowledge needs

“First it was just getting used to the department routines. Figuring out how things work and just getting comfortable where everything is [interview_novice-03]. Novice nurses talked about getting to know the practices and routines embedded in the culture of the ED. This can range from knowledge of simple procedural tasks such as how IV’s are taped in the ED to becoming familiar with the variation in individual physician patient management preferences. This differs from expert nurses who have moved past the need for routine based knowledge “I guess because I have been in tones of traumas, and resuscitations and critical sick children, that I know what the

next move is mostly. I might not know what the diagnosis is but when presented with x, y and z I know what to do and I know how to anticipate” [interview_expert_02]

“When new people ask questions, they tend to be specific, you know, it’s not sort of OK, you’ve got an asthmatic patient and these are his vitals and what would you do and what are your choices, they tend to ask more specific questions”

[interview_expert_01]. Expert nurses also recognize the type of knowledge needed by novice nurses is different.

“the stuff that comes in through triage, vitals, anything that’s pertinent to that patient, allergies, the health history and that type of thing. From the families or from the old charts, or sometimes you get a call from the family doctor”

[interview_Competent_06]. Many nurses also identified the need for patient knowledge first when asked about the knowledge needed to guide practice.

“like some kids come in with SVT’s and administering adenosine used to be like this whole mystery vortex for me but now I feel like, because I have seen it done enough and I’ve done it enough myself that I know how to assess them, I know what to expect with this medication”[interview_Competent_06]. “in some situations, I felt like I didn’t understand enough of the situation, whether it was the patient’s chief complaint or the management of it” [interview_novice_08]. Nurses also talked about a range of other types of knowledge needed to guide clinical practice which included everything from pathophysiology and pharmacological knowledge to minute details around the type of blood tubes used for specific tests. The level of detail needed varied with the level of expertise of the nurse.

“Physicians will have their different ways of practicing and their different treatment protocols, their own that they’ve developed from their experience”

[interview_novice_08]. “some of the physicians here, their way of handling patient care is really different from the general way” [interview_expert_01]. The practice preferences of particular physicians is unwritten knowledge that is generally passed on by word of mouth or discovered by trial and error.

“I use a lot of the protocols folders. We have binders with general protocols in them” [interview_novice_10]. Fewer nurses talked about the need for best practice knowledge in the form of protocols and guidelines to guide clinical practice, although this was generally mentioned after prompting.

“for the charge and triage thing you tend to ask the more experienced people” [interview_expert_01]. Administrative knowledge was also identified as an important type of knowledge by more senior nurses or nurses who function in the role of charge nurse.

“one time I went to the trauma room and “nurse A” said to me ‘you do the meds’ and it was a case where I wasn’t too sure on how it was going to go and I said ‘nurse A I’ve never done them, and I am not comfortable doing them now, I prefer to be on the other side watching” [interview_novice_08]. “I find when it comes to multisystem trauma I am not in my comfort zone” [interview_competent_06]. Most nurses highlight the trauma room as a knowledge intensive experience. Two or three nurses from the department will generally participate in the management of this scenario depending on the type of trauma. Nurses not only require clinical knowledge for managing a rapidly changing, multisystem trauma patient but they must also have the necessary leadership knowledge and skills to effectively manage the variety of teams and services that respond, and those that respond but are not required.

Knowledge Exchange Behaviours

“I remember the first time that I heard something research related that really made me think ‘wow, that’s really cool’. ... how they got this information and changed their policy and the rate of mouth sores went from this to this” [interview_expert_01]

Knowledge exchange appears to occur on a continuous basis through a range of active and passive processes. Knowledge seeking and sharing is role modeled and encouraged by both the medical and nursing staff. I observed this behavior in both clinicians and members of the leadership team. The knowledge seeking and sharing behaviours that I observed and spoke with nurses about were influenced by a number

of factors including the characteristics of the individuals involved, characteristics of the practice environment and the characteristics of the knowledge.

Processes for seeking and sharing

“the most frequent [method] is talking to the other staff. Other nurses, and in some cases the physicians too, but probably mostly the other nurses”.

[interview_Expert_01]. “if anything new comes in, I’m sure you are going to ask other people for their information or whatever they think and also I think the doctors, just listening to them teach the students is quite helpful as well...[interview_novice_03]

Knowledge exchange in this emergency department is primarily situated in an oral tradition. Knowledge seeking and sharing generally takes place on an interpersonal level, either through face-to-face interactions or over the telephone. This is a common process seen from novice to expert. When questioned about how they find knowledge to guide their practice novice and expert nurses immediately refer to their interactions with colleagues. Even when information is available in the department in the form of an evidence based guideline or policy, nurses prefer to take a more direct route by asking a colleague. During one observation session a novice nurse questioned a more senior nurse about the indications for use of an oxygen saturation monitor with a child she was caring for and who was to be sedated using chloral hydrate. [observation notes_expert_01] This information was readily available through an evidence based guideline in the department and while the novice nurse was told about the existence of the guideline, she was also given the details of the guideline directly by the expert nurse. “Nurse A [expert nurse] indicated verbally that she knows the protocols off by heart” [field notes observation session_expert_01].

“There are book people out there. There are people that just read, as a hobby and they enjoy reading. So there are junior and senior staff here that have read the current research articles and have said, ‘Oh, did you hear about such and such?’ And then they’ll discuss it. We have quiet times at the desk when people do bring stuff up and it is really fascinating to hear some of the information” [interview, novice_10] Nurses are able to speak about the specific strengths and skills of their nursing and physician colleagues. They also speak about the individual differences in motivation and

capacity to examine the research literature and they indicate that they depend on the individuals with those skills to share that knowledge with the team.

“CL (clinical leader) is in charge for the first 4 hours today. She actively engaged both nursing staff and ERP (emergency room physician) in discussion about clinical care of the patients who had been placed. One comment led to a 15 minute reflection by the ERP and 3 nursing staff of a range of past clinical cases. They discussed diagnosis, presentation of patients ie blood results, X-ray etc. They also reflected on the different reactions of parents when they bring their children to emerg [notes from participant observation 06]. In addition to specific procedural knowledge which is exchanged through a process of question and answer, nurses often share expert practice knowledge through storytelling. These types of exchanges most often took place around the ‘blue desk’ when the volume of patients in the department was low. The stories were also often preceded by the admission of a patient with a rare presentation or uncertain diagnosis and included details of how a similar case had presented to the department and how it was managed; however they also occurred spontaneously. “the charge nurse received report from the ERP and R3 about a patient coming to the ED with cellulitis. Discussion about the pros and cons of using ametop © before starting IV to administer antibiotics” [notes from observation_novice_03].

“And you can also ask the doctors, ‘why aren’t you pursuing this?’ and whatever, and they will answer you so it kind of explains why some doctors have different approaches.....I’ll ask some questions and a lot of times it’s listening to what they are saying to each other and stuff....each doctor is different so it’s sometimes frustrating, like some doctors will say ‘well it’s this or whatever’ and somebody else (another physician) will do like a mile long workup on it” [interview-novice_03]

Nurses will seek information from other nurses and physicians in the department to contribute to their own knowledge base. They will question why certain things are done or not done in particular cases. This seems to be particularly helpful for novice nurses when they observe variation in practice.

“The white board was central to the progression of the day. All the staff checked it frequently. The ERP (emergency room physician) used the board to check for completion of diagnostic tests ordered.....the charge nurse also referred to the white

board frequently. It was used when giving report to staff during handover at coffee time. When the charge nurse returned from coffee she reviewed the board immediately to evaluate the status of the department and identify what had occurred while she was at coffee” [observation notes_novice_08] The 5’ by 6’ whiteboard located on one wall inside of the nursing station is a key mechanism for sharing patient knowledge. As patients are admitted to the department a section of the board is designated for sharing information about that patient’s age, location (inside and outside the department), provisional diagnosis, and treatments. The board is used by medical and nursing staff to organize care and to guide information sharing during change of shift reports or coverage during breaks. The charge nurse or medical staff also used this board to manage and monitor the flow of patients in the department. The shorthand used to communicate information on this board is a combination of commonly used medical abbreviations and commonly accepted abbreviations that are unique to this department. As one nurse states “it’s good because that’s the main tool of communication in the emergency department. Sometimes you just kind of stand back, run down the board – be it by yourself or with the charge nurse, or whoever knows what’s going on to find out what’s going on in the department and, if you have quiet time, just to glance at it to see if anything needs to be done”[interview_novice_03].

Sources of knowledge

“so a lot of times you’re thinking I’m really not sure what that medication’s for, if the family doesn’t know, usually they do, but there’s some people that are on so many medications they’re not sure what’s for what conditions, so you check with the mom and you check with pharmacy and you check with the computer, check the CPS, you know, there’s lots of resources for medications.” [interview_competent_06]

“ a lot of it is basically my experience....it’s because you see a lot of it over and over again..[interview_novice_03] When asked about knowledge sources, nurses in this department generally start out by saying they rely on their own clinical experience to guide their practice and in novel situations they will fill in the gaps with knowledge from their colleagues or other personal sources.

“I think people resources are most frequently used because they are easy, you can just ask somebody a question as you’re passing by and still do something else as opposed to taking the time to look something up” [interview_novice_08]. “I think you learn the most from the people you work with.”[interview_novice_03] Personal sources of knowledge were the most commonly observed and commonly cited sources.

“I rely heavily on my colleagues, I find a lot of my colleagues are really good sources of information” [interview_competent_05]. Although nurses seek multidisciplinary sources within and outside the emergency department, nurses most often seek knowledge from other nurses in their department. “like some of those nurses are smarter than the doctors” [interview_novice_03] Nurses clearly value the clinical knowledge of their peers. Novice and expert nurses alike referred to their colleagues as a valuable source of knowledge.

“I found myself listening to Dr XX teach this morning about fever in a child under three months old and how you manage and the antibiotics....and the main sources of infection in this age group and everything like that. I learned so much just sitting there and listening” [interview_Novice_08]. Emergency room physicians are also commonly cited as important sources of knowledge in department.

“A lot of times for drugs the Poison Centre is amazing.” [interview_novice_03] “We’ll also call other floors to ask them questions. Like 6 north for an oncology patient or a certain med that you know that they give all the time” [interview_novice_03]. Nurses also frequently use personal knowledge sources outside of their department (pharmacy, Poison Information, and staff from specialty units) [observation_competent_05; interview_expert_02; interview_competent_06]. A typical example occurred during one observation session of a competent nurse who was preparing a medication for administration through intravenous push and found the instructions outlined in the package guidelines confusing so she called pharmacy to speak with a pharmacist for clarification [observation_notes_competent_05].

“the formulary is good because it is easily read, it’s got all the main points on it” [interview_novice_03] Explicit sources of knowledge include patient’s charts, drug formulary, specific patient protocols and guidelines [observation_expert_02;

observation_competent_05]. These sources were generally cited less often during interviews. “The patient specific protocols we use very regularly. Any time one of those kids comes in that [the protocol] gets pulled out. If they come into triage before they’re even registered the triage nurse sends a message back saying pull that person’s protocol. You know those kids have special needs and it just makes things so much smoother for them and their families and that’s a really important piece of knowledge that we have” [interview_competent_05] A number of patient specific protocols are available in a binder at the nursing station. These protocols have been developed to facilitate continuity and consistency of care for patients with chronic conditions who are frequent visitors to the emergency department. Algorithms posted in the trauma room were also identified as a valued source of information during resuscitative procedures [observation notes_expert_02].

“the one (policy) that I would think gets used most often would be the one for conscious sedation...probably because, of all the procedures that we do in the department, that one probably carries the greatest risk. If kids are under a certain age then you can’t be sedating them without anesthesia present. If they have certain medical conditions, you know, like kids with CP wouldn’t get sedated in emerg and kids with asthma who are symptomatic should not be getting sedated in emerg. I have actually, in the past, had kids with fractures that ortho wanted to sedate, who were wheezing, and I had to pull out the policy and say “no, it say right here that you have to call anesthesia” they weren’t happy, yet they did it because I had the policy.” [interview_competent_05]. Although I did not directly observe any policies or clinical practice guidelines being accessed during my observation sessions, nurses in the department are aware of them and do rely on them in practice. The conscious sedation policy was the most commonly cited example of a policy that is frequently used in the department. It seems to be primarily used by nursing staff to support their practice decisions about appropriate use of sedation with clinicians external to the department.

“I see the physicians using it too, cuz they pull it out and they say ‘okay, what do we do?’it takes the guesswork out, it take the trial and error out of it...by saying ok, we can rely on this the experts have told us this is the way you rehydrate them” [interview_novice_08]. A guideline for the “management of diabetics” was also identified by one novice nurse as important in low volume, high risk patient scenarios.

“the seriousness of the question and the urgency of the need also play into it” [interview_expert_01]. Guidelines and protocols are often used to fill in the gap when personal sources are deficient in some way or in novel situations where there is a sense of urgency or when the risk is a little higher.

Patient’s charts were identified by some nurses as an important tool for sharing patient knowledge. However, during my observations sessions charts appeared to be utilized more often by novice and competent nurses than expert nurses. During several of the interviews nurses (novice and competent) spoke about the value of patient documentation (nursing and medical notes) for sharing knowledge about the patient and were vigilant about documenting their assessments.

Although I observed some nurses [observation_novice_08] using computers for knowledge seeking in the emergency department, very few identified this as a potential source of knowledge without prompting. One nurse who was a strong advocate for using technologies such as Google Scholar or PubMed to find expert knowledge was currently enrolled in a graduate program and suggested that this may have enhanced her knowledge and skill in this area. “I think in doing my Masters at a distance, nothing was handed to me. I had to go search everything myself and it’s amazing what you can find on Google Scholar” [interview_novice_08]. Another nurse talked about using explicit sources when the knowledge about a particular medical condition was not available from the family. “Sometimes you can get the information from the family but not always. So, you know, sometimes you gotta go back and look at whatever journals you have out back or whatever textbooks or online sources, and your Googling this health condition” [interview_competent_06]

“we’ve got things like, which I like, our pediatric emergency department learning days, and things like that which is good. Like because you discuss specific illnesses or injuries, so that’s good” [interview_novice_03]. Nurses talked about formal and informal opportunities for knowledge sharing. The interactive nature of these opportunities was important.

Choosing the best source

“Expert 07 appears to be a source of knowledge for other staff (interdisciplinary). Her years of experience have provided her with tacit knowledge that is useful in many administrative and clinical scenarios. Nursing staff ask her questions about appropriate blood tubes to use for specific tests, SW (social worker) approaches her about patient that was seen the evening before and requires verification of attending the ER to get coverage from Social Services for drugs” [observation notes_Expert_07]. How nurses choose the “best” source for them is dependent on a number of factors. The more experienced nursing staff are recognized for their wealth of clinical knowledge and are often the first choice by other nurses as a reliable knowledge source. This was evident during the majority of my observation sessions. The *go to* person for administrative questions was definitely the charge nurse but if a clinical question arose the staff generally sought out the most experienced nurse on shift that day, which may or may not be the charge nurse.

“if it is more of a nurse question I may go to the girls that I know who have the experience with those types of kids, if it’s you know, a neonatal baby then you go to the girls who have had experience in neonatal. Like everybody has kind of got their own little area of expertise” [interview_competent_06]. They will often choose the personal source based on the knowledge need “if I have a question about what treatment I would use for a kid with asthma or that kind of clinical thing, you know, most nurses down here aren’t brand new grads, so you sort of ask you know everyone’s opinion, but for the charge and triage thing, you tend to ask the more experienced people.” [interview_Expert_01].

“You can tell just by the way that they respond, either verbally or through body language that it’s not something that they enjoy doing. So you tend to gravitate toward the people who are more receptive and willing for you to ask questions” [competent_05]. However, not all experienced staff are considered good sources of knowledge. Some staff are more receptive to knowledge sharing than others and as new staff become more familiar with the personalities of the other staff they come to know who they can approach with questions.

“there are just some people who, from working with them, and watching them practice, you trust more than others....and it’s just from different stuff I’ve seen and some of the things that they do in their practice compared to the majority of the other physicians that just doesn’t make sense to me....it makes me uneasy and it makes me question their judgment and so because of that I would be reluctant to seek them out” [interview_competent_05]. Staff also evaluate the trustworthiness of their peers as sources of knowledge

“And I find more with charge issues I tend to seek out the people who really know how to, the people who I think operate more like I do” [interview_Expert_01]. “If you are a doctor that orders every single test because of this symptom and this symptom, I probably won’t go to ask your opinion on a lot of things because you are just doing textbook medicine, you’re not thinking outside the box and using your experience and your knowledge that you gained from other things”[interview_expert_02]. Many nurses describe seeking out personal sources who think in the same way they do.

“I use the policy manual more because I’m on the policy committee now” [interview_novice_01] Nurses’ participation in educational, committee or research activities influenced their use and promotion of explicit sources. One novice nurse who is currently undertaking graduate studies talked about her choice of explicit knowledge resources including textbooks that she refers to at home “I always have my books by my bed” [interview_novice_08] or web based resources that she uses “One patient that we had some question about..um..I just went to the internet and went to Google Scholar and did a search and found the information and printed it off” [interview_novice_08].

“I like to have something to give to parents...um..I usually review it with them and I find that’s really helpful when you’re taking parent calls...if they say ‘my child is vomiting, I don’t know what to do’, then I usually will say to them “when you were here, did you get a vomiting and diarrhea handout?’ if they did, I’ll ask them if they have it with them and I will review it with them” [interview_competent_05]. Several nurses also talked about their use of patient handouts when working with parents. These handouts have been developed using established guidelines and appropriate literacy levels for teaching materials.

Barriers for seeking and sharing

Knowledge, skills and behaviors of individual clinician

“I am the first to admit that I am not completely on top of all evidence based practices. I am not much of a reader so I won’t read journals to find out what is new. But I am very keen if something comes up that has been deemed to be better for whatever reason. Then I’m great. I will then go and read that article, but I’m not a reader, full stop.” [interview_novice_10]

Knowledge, skills and behaviors of individual clinicians can impact both the seeking and sharing of knowledge in the emergency department. “You look across and I can’t tell you what’s wrong with them, I know I don’t like what’s going on and I have triaged kids before that they are a little tachycardic or febrile, and I’ve triaged other kids with the same numbers at 4 but this one is a 3 or a 2, and I’ll say, I can’t put my finger on it but something is not right with this person. And, you know, usually it’s right, but I can’t figure out what it is at the time. I just know from my gut, the way they’re walking or holding themselves or whatever, something’s not right and the whole picture is not adding up” [interview_expert_02] Expert nurses describe the challenges with sharing expert knowledge. I observed differences in the knowledge seeking and sharing behaviors of novice, competent and expert nurses. An example of this was noted during the observation of an expert nurse “She appears very confident and comfortable in her role as expert. However I notice that she rarely refers to the patient chart. She does read it quickly when placing a patient but seems to rely on verbal summary give by triage nurse at the blue desk. Her interactions with patients and families are brief and she rarely writes notes (she describes this as well)” [excerpt from observation notes expert_07]. Overall, expert nurses in this study relied on their strong clinical knowledge base and were less inclined to mention or refer to explicit knowledge sources.

“I’m not much of a book person. I’m more of a see it, live it, learn it, sort of thing. The internet is always available. A lot of times for drugs the Poison Centre is amazing. I think you learn the most from the people you work

with.”[interview_novice_03] Several nurses talked about their strong preference for experiential learning and personal sources over other explicit sources. “I know you can get it under the library on the computer, you know that I am probably never going to sit down and look that up. But if they said it is in this manual I would be much more apt to look it up in paper copy than going online to do it. I am still not really computer competent” [interview_expert_01]. Technology remains a challenge for some nurses.

“you can tell just by the way that they respond, either verbally or through body language that it’s not something that they enjoy doing. Um..so you tend to gravitate toward the people who are more receptive and willing for you to ask questions” [interview_competent_05]. Many nurses talked about how some nurses and physicians were more approachable or receptive than others. They also talked about choosing their sources based on their level of knowledge and experience. “I find when it comes to a multi-system trauma, that’s when I kind of think, hmmm I’m not in my comfort zone and I have a lot of questions here but the flow of that scenario is so dependent on who’s in the room, who’s leading the trauma, what nurses are there, what experience they have, how many people are there, who’s fighting over what body parts. Like you know, whether the neurosurgeons are thinking they’re more important than the orthopedics are” [interview_competent_06]

Physical layout of the department

“there were plenty of times when I was at work, where I would have had time to go do that [research a question] but there was no where private and no where quiet. There was just the computer at the back of the desk or the one in the lounge with people coming and going and to me, that’s not really conducive to learning” [interview_competent_05].

The physical layout of the department acts as both a barrier and a facilitator for knowledge seeking and sharing. The “blue desk” is an island in the middle of a very busy and active nursing station and all clinical traffic flows around it. While it is an excellent venue to listen to and at times participate in the exchange of expert knowledge between medical staff and medical residents, the volume of noise can be

distracting when trying to engage in other knowledge seeking activities. On occasion there are multiple conversations occurring at the same time around this desk and staff will often attempt to participate in more than one conversation at once. The computers, the patient white board and other explicit sources such as reference texts or the guideline binder are also located in the immediate vicinity of the “blue desk” contributing to a less than ideal environment for knowledge seeking and sharing.

Flow of patients

“If it’s really, really busy...when you get a couple of traumas, you’ve got usually one of your most senior nurses and maybe a junior nurse and your ward clerk up in the trauma room. Then there is often just a couple of you left out here with sometimes junior doctors because if there is only one doctor on he is up there as well, it can be a bit tense. If you have like a red come in while there is somebody in trauma....say you have a severe asthmatic or croup that needs dealing with now...Those particular situations can be hard, certainly on a new person. I am almost better off in the trauma room with all the support around me than trying to keep the boat afloat out here with not knowing where to find anything, or not have the understanding of the priorities as well as the senior staff do.” [interview_novice_10]. This emergency department sees between 70 and 80 different patients in a 24 period. Ensuring patients flow in and out of the department at an acceptable pace (outlined by the CTAS guidelines) is important for quality care. Accessible knowledge resources are a challenge when the daily patient census is high or when a patient with a high acuity level unexpectedly enters the department. As a professional group that relies on people knowledge sources, when nursing or medical staff numbers are low or inaccessible due to high patient volume or the presence of a trauma patient requiring multiple staff then knowledge sources are limited. Novice nurses seem particularly vulnerable in this type of situation. However, as most traumas are unpredictable it is challenging to staff the department in the event that a trauma might occur.

“Down here, you put kids in a room and you, 20 minutes later they could be gone and you have no idea what the doctor has told them and stuff like that. I like to make sure that, especially the ones that have been there for a few hours or have been worked up, that they have everything they need” [interview_novice_03]. At times, the constant

flow of patients in and out of the department can pose a challenge for knowledge sharing with families. Emergency room physicians are responsible for providing the patient teaching however, nurses in this department also feel a responsibility for ensuring families are well informed before they are discharged. I observed several episodes of nurses fielding questions through telephone calls from parents who had visited the department with their child in the preceding days. This was a point of concern expressed by several nurses during my interviews

Multiple Interruptions and demands

“The compressed nature of the emergency department stay necessitates efficient and effective processes for gathering and sharing patient knowledge “[participant observation notes_Novice_O3]. The interruptive nature of the work in this department can pose numerous challenges for finding information quickly. Novice nurses talked about how they struggled with this, particularly in the early stages of their ED career when they had limited experiential/clinical knowledge to draw from. “Time is a barrier. That’s probably the biggest thing like you said, that day was really busy and some things that I would like, you know, like you have a patient and you don’t know that much about the condition or whatever, and you’d like to read the chart but you don’t have time because you have to go with somebody else” [interview_novice_08]. Multiple interruptions and demands can prevent staff from finding the information necessary to fill in the gaps in their knowledge. “It’s the nature of an emergency department, you know, often when you need the information in a hurry, for new people [this is challenging], this is often when it’s really busy and you know, it’s hard to find time to get the information in the best way, whatever that is. You know the more urgently you need the information, usually the less time you have to get it” [expert_01]

Multiple interruptions make using a computer to find information challenging. “I think I would do better with having the actual paper or book in front of me. Cause if you have to sit at the computer and read something, and then you have to get up and go do an IV or something, you have to get off the computer and then to go back and stuff like that... I think if it’s physically in front of you, you are more apt to sit there and pick it up and read it...you can just leave it open to that page rather than have to

pull it up again, I know you can minimize and stuff but still” [interview_novice_03]. Many nurses talked about the knowledge exchange challenges that occur in the trauma room with many clinicians from different services attempting to set the pace and demanding to be heard. Nurses identified the importance of strong leadership to minimize the chaos in these situations “when you’re in there and you’re at the bedside and you’re trying to do what needs to be done and you need to rely on the people around you for the information that you need to provide the best care, you need to actually be able to hear those people. And if there are too many people around who don’t need to be there then the information sharing is not as effective as it could be....”[interview_competent_05].

Format of the knowledge source

“The protocols are good, especially when you are starting....but sometimes it’s easier to ask your colleague then go try and figure out what binder it’s in or how to get I up under PULSE (health centre intranet site) and stuff like that....”
[interview_novice_03]

A number of barriers were identified regarding the way in which explicit knowledge sources are available or accessible in the emergency department. Nurses appeared to prefer personal sources over text sources because the route to the needed knowledge was faster.

“A lot of the books we have here...textbooks and everything, are quite old....I think if we had some more updated nursing books that were well kept and easy to refer to [people would use them]” [interview_novice_08] The currency of the resources were called into question by several informants.

“I find PubMed sometimes you get a lot of articles that are not...that are too technical, that you don’t really need” [interview_novice_08]. “certainly for the older nurse who, you know, went to a hospital-based three-year program and who probably learned nothing about research back then...they probably wouldn’t know how to get the best information out of an article like that even if they did read it [interview_expert_01]. Many nurses also referred to the skill set required to read and interpret findings from the scientific literature. Suggestions for overcoming this information literacy deficit

included nursing journal clubs and oral summaries of relevant literature provided by nursing or medical staff in the department.

Discussion

There is a strong oral tradition of knowledge exchange for nurses in this emergency department. Knowledge is exchanged through a vibrant social network where, overtime, nurses come to know and trust a range of personal knowledge sources. Nurses are aware of the availability of other sources of knowledge but choose to inform their practice by knowledge gained through their experience and interactions with other nurses and physicians in their department. These findings are consistent with other studies examining sources of knowledge in the nursing literature (Gerrish, Ashworth, Lacey, Bailey, Cooke & Kendall, 2007; Estabrooks et al, 2005 ; Ozsoy & Ardahan, 2008). Nurses prefer to use personal sources because this route takes less time to get to the exact information required but also because it fits with the social nature of practice in this department. Nurses generally discriminate between credible and non-credible personal sources, making judgments based on the years of experiential knowledge of the source and their own observation of the source in practice. Nurses will also seek personal sources (nursing and non-nursing) outside of their department when the clinical situation calls for expert knowledge outside of the available resources in their department. Sharing knowledge in this way and learning from one another's experiences contribute to the development of a learning organization. (Chunharas, 2006) This type of an environment creates numerous opportunities to translate different types of knowledge into practice.

Expert nurses may not need the same level of detailed knowledge required by novice or competent nurses in practice. This may account for the differences in expert and novice use of explicit sources such as patient charts. With limited experiential knowledge, novice and advance beginner nurses are typically task oriented and rely on rules to govern their practice (Benner, 1984). This may affect their ability to find contextual meaning in some explicit knowledge sources. Expert nurses, on the other, hand have a rich experiential knowledge base on which to interpret new knowledge. This expert source of knowledge is a valuable resource that is limited if not shared with novice nurses or patients and families. Nurses' use of explicit sources is often

triggered by high risk, low volume patient situations. Nurses reported using clinical practice guidelines and protocols in an instrumental way to validate their thinking or support decision making.

Knowledge sharing frequently takes place through a process of mentoring or storytelling. As an academic centre, formal mentoring occurs on a regular basis between clinicians and students (medical and nursing). It is interesting to note the differences in style between medicine and nursing for this type of knowledge exchange. The nurse preceptors are less inclined to question the nursing students about their observations or thoughts and more inclined to simply offer relevant information or their own reflections regarding the particular patient scenario. This difference may be due to the fact that, unlike medical staff, nurse preceptors in this emergency department do not have a formal affiliation or appointment with the university. Therefore their role in formal evaluation of the nursing student is minimal. Formal written position statements defining the role of the nurse preceptor with specific selection criteria in clinical teaching are important (Oermann, 1996). Barriers to the role have been identified as lack of recognition by other nursing staff, lack of support by faculty advisors, limited formal preparation, time and limited contact with the educational program (Bourbonnais & Kerr, 2007; Heale, Mossey, Lafoley & Gorham, 2009). Engaging learners in reflective discussion regarding clinical problem solving requires time and preceptor training. Mentor confidence is related to education (Heale et al., 2009). Nurses in this department carry out the preceptor role in addition to their clinical responsibilities, with limited connection to the university nursing program or preceptor training. Formal structures exist in the health centre to support and coordinate medical residency training, including an emergency room physician designated to oversee emergency medicine resident training, however this type of structure is not present in the health centre to support nursing students. Lack of time, support, formal affiliation and training may contribute to a lack of confidence by nurse preceptors to engage in reflective teaching. The difference in medical and nursing mentoring styles may also reflect differences in the length of formal clinical training and the training culture in nursing and medical schools, broad curriculum versus case-based or problem oriented approach.

Storytelling is also embedded in the culture of this department. The sharing of procedural knowledge is often “wrapped” in a clinical story about a similar case with explanations about how variations in patient presentation impact application of the procedural knowledge. This activity is often precipitated by the presentation of an uncertain or unusual diagnosis or it may be triggered by a question posed by a nurse or physician at the “blue desk”. Mentoring and storytelling have been identified in the literature as useful strategies for knowledge transfer (Swap, Leonard, Shields, & Abrams, 2001). When done effectively knowledge is shared in context which may help to relay meaning. These strategies can also be useful in establishing a sense of community and help to build relationships. Many of the knowledge seeking and sharing processes found in this department are similar to descriptions of communities of practice where interdisciplinary discussion and debate occurs within the context of practice. Interdisciplinary collaboration in emergency care has been linked with research utilization (Hansen, Bios, Delaney, & Schug, 1999)

Knowledge sharing also takes place through formal processes that have been well established by various administrative structures and committees in the department. These structures demonstrate a visible commitment to knowledge exchange and utilization. While there is a strong nursing presence in many of these structures, in some of the more interactive formal structures such as journal clubs and morbidity and mortality rounds, where best practice knowledge is discussed and debated, the presence of nursing is limited. This presents as an important gap as participation in these types of activities facilitate the use of knowledge in practice (Kitson et al 1998).

A number of knowledge exchange barriers exist for nurses in this emergency department. These barriers can be classified using the Model for Knowledge Exchange and Utilization in Emergency Practice. Individual barriers include deficits in information literacy, particularly as it relates to finding and interpreting explicit sources of evidence. In addition, the current reliance on personal sources contributes to nurses seeking out sources who think in the same way as they do, which limits opportunities to challenge or debate best practice knowledge. Nurses must learn to value knowledge from multiple sources and use their clinical judgment to weigh and evaluate the evidence. Novice and expert nurses have different information needs and would benefit from different knowledge exchange strategies. Barriers related to the

context of practice include the physical layout of the nursing station, the interruptive nature of the practice environment and limited interactive formal structures that are inclusive of nurses. Current and relevant explicit knowledge sources that are easily accessed and structures to enhance information literacy were also identified as important barriers.

Limitations

This ethnographic research study has a number of limitations. Ethnography relies on observations that take place in a natural setting; therefore, it difficult to control for external variables. Distractions were present during some of the observation sessions that took place during busy or noisy shifts and it is possible that I did not capture all knowledge exchange events. However, notes were taken immediately following the observation session and participant interviews did provide an opportunity to clarify observed events. This ethnography was focused on examining the knowledge exchange of nurses in an urban ED. This has led to an in-depth knowledge of the knowledge exchange behavior and culture in one particular setting but limits the breadth of this study. While there are those who would argue that it is possible to generalize from one ethnography to theory (Myers, 1999), further ethnographies in different ED settings would strengthen the meaning of knowledge exchange presented in this work.

Conclusion

The knowledge exchange and utilization patterns of nurses in emergency practice are not well understood. The knowledge seeking and sharing activities of nurses from a pediatric tertiary care emergency department were explored through a process of observations and interviews. Ethnographic research is informed by the day-to-day involvement of the researcher in the everyday life of the group being studied. Nurses in this ED valued knowledge in practice and primarily used an oral tradition to seek and share knowledge. Knowledge from expert sources was used in a symbolic way to validate a decision and instrumentally in protocols to guide practice. Nurses identified a number of barriers for knowledge exchange in emergency practice including characteristics of the individual clinicians and characteristics of emergency practice

settings. The findings from this study offer supporting evidence for the dimensions (individual, context of practice, knowledge) of the Model for Knowledge Exchange and Utilization in Emergency Practice. Much of the knowledge exchange and utilization literature is focused on exchange between researchers and clinicians. Yet, much of the knowledge exchange that occurs in practice takes place between clinicians. Understanding the knowledge exchange behaviors of this group will assist in identifying opportunities to strengthen the knowledge exchange processes with best practice knowledge and develop new strategies to overcome the barriers. The findings from this study make a new contribution to the knowledge exchange literature by identifying barriers for best practice knowledge exchange between clinicians in emergency practice settings. However, further ethnographic studies in different ED practice settings would strengthen the interpretive meaning presented in this study.

Study III

Introduction

Changing provider behavior is challenging, as a complexity of factors are known to facilitate or impede the uptake of evidence (Powell, 2003). Before we can develop interventions to enhance the exchange and use of evidence in emergency practice settings we must first understand the factors that influence or underlie the knowledge exchange behavior in this setting. This presents as a gap in the current emergency practice knowledge translation literature. The purpose of this program of research was to explore knowledge exchange and utilization in emergency practice settings. The **Model for Knowledge Exchange and Utilization in Emergency Practice** was developed through a process of reflection on experiential knowledge and a review of pertinent knowledge exchange and utilization literature. Three main dimensions-- *individual, practice context and knowledge*---- have been identified as relevant to the exchange and use of research and practice knowledge in an emergency practice setting. We know that the effectiveness of interventions to change health provider behavior varies across different clinical problems, contexts and organizations (Grimshaw, Thomas, MacLennan, Fraser, Ramsay, & Vale, 2004). Study I and Study II of this dissertation provided a strong emergency nursing perspective across a number of settings. In this third study we propose to further develop and challenge the model with a series of clinically significant emergency case studies explored by

means of telephone interviews with emergency physicians from rural and urban EDs in Nova Scotia.

Questions:

1. Are the dimensions of *individual*, *practice context* and *knowledge* relevant for explaining emergency physician's use of a clinical practice guideline?
2. What are the perceived barriers and facilitators to using clinical practice guidelines in emergency practice settings?

Methods

This third study used a case study methodology. Case studies are useful when examining complex issues (Yin, 2002) such as knowledge exchange and utilization in emergency practice settings. Both qualitative and quantitative data are usually gathered in case study methodology. In this study, application of a series of real-life case studies that cross a number of settings and clinical scenarios were used to identify a broad range of relevant factors applicable to knowledge exchange and utilization in emergency practice. A convenience sample of physicians from one urban (city; population more than 50,000), one semi-urban (town; population between 10,000 to 50,000) and one rural (town; population less than 10,000) emergency department setting in Nova Scotia were used to construct the cases. Ethics approval was obtained from each participating site. Sites were identified through a letter of invitation that was sent to the medical directors of all 22 emergency departments in Nova Scotia. Positive responses were grouped by type of emergency department (urban, semi-urban, rural) and entered into a database. Centers who agreed to participate were randomly selected using a random numbers chart. To ensure inclusion of a pediatric emergency case we specifically invited the provincial pediatric emergency department to participate resulting in a total sample of 4 cases from 4 EDs. The medical director from each of the selected centers were contacted by telephone by the Principal Investigator and asked to identify a recent (within the past year) change in pediatric/adult clinical practice that had occurred in their center and had been accompanied by a clinical practice guideline or protocol. They were asked to rate the change in practice regarding level of risk (high/low) to the patient and volume of patients (high/low) affected. The change-in-practice case scenarios described by the medical directors provided a focus for the physician interviews. Medical directors

were also asked to provide demographic data regarding their ED (number of medical/nursing staff, usual sift coverage, patient census data). Medical directors were asked to send a letter of invitation to all physicians in their department who worked a minimum of 3 shifts per month. Physicians were offered an honorarium as an incentive to participate. A maximum target of 3 physician interviews per ED was set to contribute to developing the site specific case. Physician participation involved completion of a 10 -15 minute telephone survey to talk about the change in practice outlined in the clinical scenario that was identified by their medical director. The telephone survey consisted of a series of closed and open-end questions. Item development was guided by the 3 dimensions (individual, practice context, knowledge) from the **Model for Knowledge Exchange and Utilization in Emergency Practice**. A total of 32 closed ended items (Appendix E) were used to link the 3 dimensions (individual, context of practice, knowledge) to the target clinical case scenario that had been identified by the medical director. Therefore each ED had a slightly different questionnaire. The stem of each of the items (example: I have the skills necessary to appraise the research literature on) was consistent across all surveys but the clinical scenario (example: use of metered dose inhalers for children with asthma) was unique to their ED. A minimum of 3 questions per dimension were included. Respondents were also asked to comment on the relevance of each of the items to their decision to engage in the practice outlined in the clinical scenario. Questions were scored using a 4 point Likert Scale (agree/disagree, relevant/not relevant). The physician's current practice behavior in the clinical scenario (dependent variable) was captured using one item. For example if the ED had recently implemented a change in practice that involved use of metered dose inhalers for children who present with mild asthma, the behavior item asked: "Of the last 10 children you saw with asthma in the ED, with how many did you use metered dose inhalers?"

Open-ended questions were used to identify the physician's general perceptions of the barriers and facilitators to knowledge exchange and utilization regarding the site specific clinical case. Demographic data regarding the number of years experience in emergency practice and the specific number of shifts worked per month was also captured. The survey was field tested with 3 ED physicians not involved in the study and 4 items were reworded for clarity prior to implementation.

Analysis

Data were analyzed graphically and descriptively from a within-case and cross-case perspective. Descriptive statistics (frequencies, means, medians) were used to describe the distribution of items in the scale. Reliability of the multi-item scale was evaluated using Cronbach's alpha. Evidence of relationships between dimension items and relevance items were explored using Spearman's correlation coefficient. A mean score was calculated for each of the dimensions. A matrix was constructed to compare and contrast the ED sites and the mean scores on the 3 major dimensions. Bar charts were created for better visualization and comparison across cases. Scores on the survey items were dichotomized (disagree/agree, not relevant/relevant) and Chi Square or Fisher's exact test was used to explore the relationship between practice behavior (dependent variable) and construct and relevance items (independent variable). Content analysis was carried out on all responses to the open questions. The barriers and facilitators were grouped into themes and a list of the most frequently mentioned to least frequently mentioned was created.

Results

Setting

Four cases were developed from 2 urban (1 mixed, 1 pediatric), 1 semi-urban and 1 rural ED in Nova Scotia (Table 10). Annual census ranged from 2,944 to 42,000 and each centre provided 24 hours coverage. All EDs reported having double coverage of physicians during peak flow periods.

Table 10. Description of Participating sites Study III

Type of ED	Setting	Annual Census	# Medical Staff	Coverage
Pediatric, Academic, Tertiary Care Centre	Urban	27,000	21	24 hour
Mixed, Tertiary Care Centre	Urban	42,000	18	24 hour
Mixed, Tertiary Care Centre	Semi-Urban	35,000	20	24 hour
Mixed, Tertiary Care Centre	Rural	2,944	8	24 hour

Case Studies

Case 1 (Table 11) arose from a pediatric ED and involved the implementation of a change in practice related to the use of metered dose inhalers for children with Asthma. The change in practice was supported by the Pediatric Asthma Care Map, a best practice guideline developed locally and based on best practice national asthma guidelines. Prior to the introduction of this guideline, respiratory medication was generally administered through a nebulization mask. The ED involved is an academic teaching hospital with a strong research infrastructure. Asthma is the third most common reason for admission to this ED and as such affects a high volume of patients.

Case 2 (Table 11) also arose from an urban ED however; this ED receives both adult and pediatric patients. The target patient population in this case was adults with chest pain who were assessed in the community by paramedics prior to transporting to the ED. The assessment information was relayed electronically to the physician in the ED who decided whether the patient should receive pre-hospital administration of thrombolytics. It is known that early administration of thrombolytics in patients with myocardial injury will improve patient outcomes, however prior to this change in practice this decision making was performed in the ED after physicians had seen the patient. This change in practice was supported by a protocol that was developed locally and based on national standards. This ED was the first in the province to implement this change in practice and although it affected a small volume of patients, the risk associated with this practice was considered to be high.

Table 11. Detail Summary of Case Studies

	Change in practice	Target Population	Volume Affected	Risk Level	CPG	Setting
Case 1	Use of metered dose inhalers for children with asthma	< 16 years	High	Low	Yes	Urban (Pediatric)
Case 2	Pre-hospital administration of thrombolytics to patients with chest pain	> 16 years	Low	High	Yes	Urban
Case 3	Use of conscious	>16 years	Low	High	Yes	Rural

	Change in practice	Target Population	Volume Affected	Risk Level	CPG	Setting
	sedation for adults with shoulder dislocation					
Case 4	Use of metered dose inhalers and early steroids in children with asthma	<16 years	High	Low	Yes	Semi-urban

Case 3 also targeted a low volume, high risk change in practice involving the use of conscious sedation with adults who presented to this rural ED with shoulder dislocation. This practice has resource implications as it necessitates involvement of health professionals from a number of disciplines and one-on-one monitoring of the patient. The change of practice was supported by a guideline that was developed locally but based on provincial guidelines.

Case 4 arose in a semi-urban general ED that receives both adults and children. The change in practice in this case related to a large volume of the total pediatric population seen in this ED, however it carried minimal or low risk. The new asthma guideline which was developed locally and based on national guidelines included a standing order sheet to assist with use.

Participants

Twelve physicians (6 urban, 3 semi-urban, 3 rural) participated in the telephone interviews which lasted 12 to 15 minutes. The emergency practice experience of participants ranged from 1 year to 26 years. Four had less than 5 years experience. However, the majority had 10 or more years of experience.

Telephone surveys

The reliability of the 32 item scale was strong with Cronbach's alpha of .82. The majority of participants agreed that items from all three dimensions were either relevant or very relevant to their decision to participate in the evidence based change in practice. Knowledge exchange with health professionals from other EDs (item 4b)

was ranked as relevant or very relevant to their decision making by all participants from the rural case however knowledge sharing with peers from other EDs was considered not relevant by 66% (4/6) of their urban counterparts. A similar scenario occurred with item 5 (other physicians approval of my practice is important to me). Rural clinicians participating in a high risk, low volume change in practice identified other physician's approval of their practice as very relevant to their decision to engage in this practice. Most physicians felt the change in their practice would improve patient outcomes (item 13) however, few physicians across the 4 cases perceived their ED was monitoring patient outcome related to the change in practice (3/12; 25%).

Table 12. Item level descriptive statistics of survey from Study III

Item*	Mean	Median	Mode
1. I have the skills necessary to critically appraise the research literature	3.42	3.50	4
1b. In your estimation how relevant are the skills to critically appraise the research literature to your decision	3.42	3.5	4
2. I have spoken with physicians in my ED about	3.58	4	3
2b. In your estimation how relevant is your discussion about this practice with other physicians in your ED to your decision	3	3	4
3. I have spoken with health professionals from other disciplines in my health centre about	3.33	4	4
3b In your estimation how relevant is your discussion about this practice with health professionals from other disciplines to your decision	2.83	3	3
4. I have spoken with health professionals from other EDs about	2.83	3	3
4b. In your estimation how relevant is your discussion about this practice with health professionals from other EDs to your decision	2.75	3	2,3**
5. Other physicians approval of my clinical practice is important to me	3.17	3	3
5b. In your estimation how relevant is other physicians approval about your clinical practice to your decision	2.67	2.50	2
6. I have participated in a continuing education activity about	3	3	4
6b. In your estimation how relevant is your participation in a CE activity about this practice to your decision	3.08	3	3
7. I have adequate access to relevant information sources about XXX in my ED	3.42	4	4
7b. In your estimation how relevant is adequate access to related information sources to your decision	3.42	3.50	4
8. Our ED is committed to	3.67	4	4
8b. In your estimation how relevant is your EDs commitment to this practice to your decision	3.33	4	4
9. Our ED is monitoring patient outcomes for	2.17	2	2
9b. In your estimation how relevant is your EDs monitoring of patient outcomes to your decision	2.17	2	1,2**
10. Our ED values the use of research evidence to guide practice of	3.33	3.50	4
10b. In your estimation how relevant is your EDs value of research to guide practice to your decision	3.17	3	3
11. I had adequate opportunity to provide input into the decision to	3.17	3	3,4*
11b. In your estimation how relevant is your opportunity to provide input on the decision to change this practice to your decision to	3.17	3	3

Item*	Mean	Median	Mode
12. Our ED provided adequate information to physicians about the use of XXX prior to implementing the change	3.42	4	4
12b. In your estimation how relevant is your EDs provision of adequate information to the physicians on the procedure to your decision	3.17	3	4
13. Doing XXX will improve patient outcomes	3.58	4	4
13b. In your estimation how relevant is improved patient outcomes to your decision to use	3.75	4	4
14. It is difficult to use in our ED	1.42	1	1
14b. In your estimation how relevant is the ease with which you can carry out this procedure to your decision	3.42	4	4
15. It is clear to me when I should use XXX and when I should not.	3.58	4	4
15b. In your estimation how relevant is the clarity of when to use this intervention to your decision	3.58	4	4
16. The guidelines for use of XXX in our ED are important	3.50	4	4
16b. In your estimation how relevant is the importance that your EDs places on guidelines to your decision	3	3	3

Note: *Items in this table reflect the common stem for all 4 case studies, **two modes

The relationship between dimension items and relevance items were examined using Spearman's correlation coefficient. Significant relationships were found in 6 of the 16 pairs (items 4,5,6, 10,11,13). Items 4, 5 & 6 are situated in the individual dimension. Items 10 and 11 are included in the context of practice dimension and item 13 is located in the knowledge dimension. In each case the correlation between the item and the perceived relevance to decision making was positive, such that the stronger their agreement with the item the more relevant they felt it was to their decision making.

Table 13. Correlation between item and relevance to practice decision

Item	Relevance	Spearman's Rho
1. I have the skills necessary to critically appraise the research literature	In your estimation how relevant are the skills to critically appraise the research literature to your decision	.398
2. I have spoken with physicians in my ED about	In your estimation how relevant is your discussion about this practice with other physicians in your ED to your decision	.251
3. I have spoken with health professionals from other disciplines in my health centre about	In your estimation how relevant is your discussion about this practice with health professionals from other disciplines to your decision	.429
4. I have spoken with health professionals from other EDs about	In your estimation how relevant is your discussion about this practice with health professionals from other EDs to your decision	.621*
5. Other physicians approval of my clinical practice is important to me	In your estimation how relevant is other physicians approval about your clinical practice to your decision	.860**

Item	Relevance	Spearman's Rho
6. I have participated in a continuing education activity about	In your estimation how relevant is your participation in a CE activity about this practice to your decision	.577*
7. I have adequate access to relevant information sources about XXX in my ED	In your estimation how relevant is adequate access to related information sources to your decision	.417
8. Our ED is committed to	In your estimation how relevant is your EDs commitment to this practice to your decision	.352
9. Our ED values the use of research evidence to guide practice of	In your estimation how relevant is your EDs value of research to guide practice to your decision	.548
10. Our ED is monitoring patient outcomes for	In your estimation how relevant is your EDs monitoring of patient outcomes to your decision	.706*
11. I had adequate opportunity to provide input into the decision to	In your estimation how relevant is your opportunity to provide input on the decision to change this practice to your decision to	.615*
12. Our ED provided adequate information to physicians about the use of XXX prior to implementing the change	In your estimation how relevant is your EDs provision of adequate information to the physicians on the procedure to your decision	.283
13. Doing XXX will improve patient outcomes	In your estimation how relevant is improved patient outcomes to your decision to use	.711*
14. It is difficult to use XXX in our ED	In your estimation how relevant is the ease with which you can carry out this procedure to your decision	.056
15. It is clear to me when I should use XXX and when I should not.	In your estimation how relevant is the clarity of when to use this intervention to your decision	.314
16. The guidelines for use of XXX in our ED are important	In your estimation how relevant is the importance that your EDs places on guidelines to your decision	.572

* P<.05

**P<.0005

In general higher item scores reflect a more positive condition for knowledge exchange and use. Comparison of mean dimension scores across case studies reveals a pattern of lower scores in Case 2 and 3 when compared with Case 1 and Case 4 (Table 14). Although this difference is not significant, it is interesting to note that Case 1 and Case 4 are focused on a pediatric population where the practice change affects a high volume of patients with minimal risk associated with the practice change. The change in practice in Case 2 and 3, on the other hand, affects a low volume of patients with higher risk associated with the practice.

Table 14. Mean Dimension Scores Across Case Studies

Dimension	Case 1 Mean (SD)	Case 2 Mean (SD)	Case 3 Mean (SD)	Case 4 Mean (SD)	ANOVA
Individual	3.208 (2.097)	2.916 (.1179)	3.00 (.7637)	3.667 (.1667)	1.81
Context	3.333 (.3042)	2.583 (1.060)	2.944 (.0962)	3.667 (.333)	2.73
Knowledge	3.063 (.1250)	3.000 (.0000)	2.917 (.1443)	3.083 (.1443)	1.07

No difference was found between item scores and adherence to the practice change (dependent variable). The majority (9/12) of physicians reported using the new knowledge in 100% of the previous 10 cases seen in the ED. Only one incidence of low adherence (7/10) was reported and this was related to Case 2.

Barriers and Facilitators

A number of barriers and facilitators for changing clinical practice were identified at the patient, provider, context of practice and knowledge level (Table 15). Many of these barriers are amenable to change with education, increased interdisciplinary collaboration, increased opportunities for interorganizational knowledge exchange and assessment of resources.

Table 15. Barriers and Facilitators For Changing Clinical Practice

	Patient	Provider	Context	Knowledge
Barriers	- Patient preferences - Variation in patient presentation	-Experience - Education - Resistant to change -Workload concerns	-Time - Staff resources - Overcrowding - Adequately stocked medications	- Compatibility with traditional practice -Medical-legal concerns - Concerns about cost benefit analysis -Clarity of evidence
Facilitators	- Education	- Commitment to change	- Commitment to change	- Clear Guidelines

	Patient	Provider	Context	Knowledge
		- Continuing Education	- Staff resources - Communication between team members	- Improved patient outcomes

A number of different types of barriers were identified across the case studies. Patient specific barriers were unique to Case 1 and 4 (use of metered dose inhalers in children with asthma) (Table 16). This practice affects a high volume of the children who visit the ED, often with parents or caregivers. Parents past experiences with ED visits and their comfort with change can pose a challenge for knowledge exchange and may influence their acceptance of the new practice. Adequate resources (experiential knowledge of the emergency physician, availability of specialist clinicians to support the practice change) were the most commonly cited barrier in the Case 2. The use of conscious sedation affects a small volume of patients in this department but carries a high risk and has significant resource implications which may be challenging for smaller urban centres.

Table 16. Comparison of Barriers and Facilitators Across Cases

	Patient	Provider	Context	Knowledge
Case 1	X	X	X	X
Case 2		X	X	X
Case 3		X	X	X
Case 4	X	X	X	

Discussion

Relevance of dimension items

A number of factors are known to influence the diffusion of knowledge in practice (Greenhalgh et al., 2004). The complex nature of this phenomena also makes research in this area messy (Dopson, 2007). The challenges and complexities of knowledge exchange and utilization in emergency practice vary depending on the characteristics of the new knowledge, the professional groups involved and the characteristics of the context in which the new knowledge is being diffused. Case study method used in this

study provided the opportunity to examine the dimensions of the Model for Knowledge Exchange and Utilization in Emergency Practice across a variety of clinical scenarios and a range of settings. This approach highlighted the complex nature of emergency care and helped to reveal some of the knowledge exchange and utilization challenges under different practice conditions.

The majority of dimension items were considered relevant across all 4 case studies. Higher dimension scores suggested a more favorable condition for knowledge application. Mean dimension scores differed across cases with the high volume, low risk cases (Case 1 and 4) producing higher scores across all three dimension than the low volume, high risk cases. Although these differences were not significant the pattern might suggest that the model dimensions are useful for explaining knowledge exchange and utilization across a number of clinical scenarios.

Barriers and Facilitators

The change in practice in each of these cases was supported by an evidence based guideline however; the presence of available guidelines does not necessarily lead to use (Grimshaw, Eccles, Walker, & Thomas, 2002). A range of barriers and facilitators related to the characteristics of the individual clinician, the structure of the guideline and characteristics of the patient or the environment are known to influence adherence to guidelines (Cabana, Rand, Powe, Wu, Wilson, Abboud, Rubin, 1999). Variation in the use of explicit knowledge tools have also been identified in emergency practice settings (Hsieh & Yealy, 2005; Brehaut et al 2006). Physicians in this study identified a number of possible barriers and facilitators which might influence the use of knowledge in the four cases examined in this study. Case 2 involved a low volume, high risk change in practice in a rural setting with a total medical staff compliment of 8. Two of the three physicians interviewed to contribute data to build the case had less than 2 years of ED experience. Experience has been identified as an important factor influencing practice behavior in emergency settings (Heines et al, 2006; Berk, Welch, Levy, Jones, Arthur, & Kuhn, 2008). Lower volume of presentations in an ED may also influence practice (Schull et al 2006). Interorganizational networks are important to facilitate knowledge exchange and can extend the community of practice. Cases 1 and 4 presented a high volume change in practice and highlighted the importance of knowledge exchange with patients and families. Mandated guidelines have the

unintended potential of negating patient preferences (Hartzband & Groopman, 2009). However, the diffusion of new knowledge into practice directly affects patients and families and requires a process of shared decision making. Common barriers identified across all cases included time, resistance to change and limitations in human and physical resources. These findings are consistent with other studies examining knowledge in practice (Cochrane et al, 2007; Strickland & O’Leary-Kelley, 2009). Participants also identified a number of facilitators which would be useful for the development of context specific and general knowledge exchange strategies.

Limitations

A number of factors limit the results of this study. First, the case topics were chosen by the medical directors in the various EDs. Although the medical directors were provided with criteria to guide case selection, it is unclear if the complexity of the change in practice and conditions in their specific ED biased their choice. Different cases may have challenged the model more extensively. It is acknowledged that reported barriers and facilitators in each ED would likely vary if different cases were examined. Two of the four cases were focused on the use of metered dose inhalers which limited the breadth of the examination however; they were different settings (urban-pediatric, semi-urban). A convenience sample of two to three physicians were interviewed from each site. A larger sample, particularly in the larger centres, may have provided different results. Physician participants were asked to report the frequency with which they used the guideline in their practice. Studies show that physicians often overestimate when reporting their practice behavior (Adams, Soumerai, Lomas, Ross-Degnan, 1999). Chart audits would provide better estimates of guideline adherence. Although the case study method creates an opportunity to explore specific and rare cases in detail it is impossible to generalize the findings to a wider population.

Conclusion

Care in rural and urban emergency practice settings is generally provided through multidisciplinary teams. Patient presentation to the ED is often unpredictable, with illness severity ranging from non-urgent to resuscitative. We know that resources and patient outcomes are known to vary across rural and urban centers in Canada (CAEP, 2002). We also know that quality care is dependent upon the use of expert (research and practice) knowledge, however little is known about the specific factors that contribute to exchange and utilization of expert knowledge in emergency practice settings. This study used a case study method to reveal knowledge exchange and utilization challenges across a number of clinical scenarios. The dimensions of the **Model for Knowledge Exchange and Utilization in Emergency Practice** were relevant across a variety of clinical scenarios and a range of settings. Barriers to knowledge exchange were identified at the level of the patient, provider, context of practice and knowledge. The results of this study will contribute to refining the **Model for Knowledge Exchange and Utilization in Emergency Practice**. Understanding and recognition of the factors that influence the use of knowledge in emergency settings should lead to development of interventions that will be successful in changing provider behavior and improving health outcomes.

Chapter 5: Discussion

The existence of a gap between best practice knowledge and practice is a consistent finding in the health services literature (Grimshaw et al 2002). Barriers and facilitators for use of knowledge to guide best practice can be found at a number of levels (Van Bokhoven, Kok, & Van der Veijden, 2003). Understanding how knowledge flows through emergency practice settings is an importance first step in identifying strategies to close the knowledge to practice gap in emergency practice. The purpose of this research project was to identify factors relevant to knowledge exchange and utilization in rural and urban EDs with the aim of developing and refining a **Model for Knowledge Exchange and Utilization in Emergency Practice**. A series of studies were carried to help identify barriers and facilitators relevant to knowledge exchange and utilization in the ED and to assist in refining the **Model for Knowledge Exchange and Utilization in Emergency Practice**. The underlying premise in this project was that one method alone would not adequately elucidate the intricacies of the model components therefore a mixed method design was employed. A mixed methods research design uses both qualitative and quantitative data collection and analysis strategies in a sequential or parallel manner (Teddlie & Tashakkori, 2003). A major strength in this design is the opportunity for presenting a greater diversity of views. In this project quantitative and qualitative methods were used sequentially with both methods being given equal priority. Each of the three studies were conducted and analyzed independent of each other, following the rules and assumptions of each methodological paradigm. Data were gathered from physicians and nurses in rural and urban settings. Triangulation of data and methods (multiple triangulation) assisted in interpretation of findings and contributed to a broader understanding of knowledge exchange and utilization in an emergency practice context.

Overview of project studies

Study I was a quantitative study involving the use of a self-report questionnaire. The overall goal for Study I was to evaluate the utility of the Model for Knowledge Exchange and Utilization in Emergency Practice for explaining participation in a novel web based knowledge sharing intervention. Participants in this study included a

sample of emergency clinicians from rural and urban EDs in Nova Scotia who were invited to participate in the *Multidisciplinary Pediatric Emergency Care Web Based Learning Project* between February 2004 and October 2005. Item development for the questionnaire was guided by the Model for Knowledge Exchange and Utilization. A four point Likert scale was used to capture data related to the three major dimensions in the model; individual, practice context and knowledge. The following research questions guided data collection and analysis: 1. Are there specific individual or practice context factors which impact participation in a web based knowledge sharing intervention? 2. What are the individual practitioner's perceptions of the organizational expectations regarding use of knowledge in practice? 3. What are the preferred sources of knowledge used by rural and urban emergency nurses and physicians to guide practice?

The second study was a qualitative study using an ethnographic approach to gain an in-depth understanding of the knowledge exchange and utilization behaviours of nurses in emergency practice. Participant observations and key informant interviews were carried out over a one year period with 10 nurses (4 novice, 3 competent, 3 expert) from an urban pediatric emergency department. The study was guided by the following research questions: How do nurses typically seek and share knowledge in a pediatric emergency department? What types of knowledge do nurses require for practice in an emergency practice setting? How do emergency nurses use knowledge in practice? What are the common knowledge sources used by nurses in a pediatric emergency practice settings. What do nurses perceive as barriers and facilitators for knowledge exchange and use in a pediatric emergency department?

The third study used a case study methodology to further develop and challenge the model constructs. Case studies are useful when examining complex issues such as knowledge exchange and utilization in emergency practice settings. Both qualitative and quantitative data are usually gathered in case study methodology. In study 3 a series of real-life case studies that crossed a number of settings and clinical scenarios were used to identify a broad range of factors relevant to knowledge exchange and utilization in emergency practice. Case studies were developed following interviews with the chief of each participating ED. Case studies were then linked with the three model dimensions in a structured interview tool. Telephone interviews were carried

out with consenting physicians at a time of their choosing Participants in this study were a convenience sample of 12 physicians from rural, semiurban and urban EDs in Nova Scotia. The following questions guided data collection and analysis: 1. Are the constructs of *individual*, *practice context* and *innovation* relevant for explaining emergency physician’s knowledge exchange and utilization behavior? 2. What are the perceived barriers and facilitators to knowledge exchange and use in rural and urban emergency practice settings?

Table 17. Overview of Studies I, II, III

	Setting	Sample	Method	Design
Study I	9 Rural 2 Urban	17 Physicians 87 Nurses	Quantitative	Survey
Study II	1 Urban	10 Nurses	Qualitative	Participant Observation Interview
Study III	1 Rural 2 Urban 1 Semi-Urban	12 Physicians 4 Medical Directors	Qualitative	Case Study

Data Triangulation

Relating the data can be a challenging task in triangulation, particularly when the volume of data is large and the different methodological approaches lead to conflicting outcomes. A similar challenge can arise when a clinician uses multiple forms of knowledge to inform their practice. However, this body of research arises from an epistemological position where various types of knowledge are needed to provide a comprehensive understanding of a phenomenon. Foss and Ellefsen (2002) suggest viewing the knowledge produced as “different positions on a continuum of knowledge” (p. 244) rather than incompatible sources of knowledge. Data produced from the different methodological approaches in this work varied in breadth and depth regarding the different model dimensions. Data from the three studies were organized in a matrix structure around the three model constructs (individual, context, knowledge) for better visualization of converging, conflicting and new themes (Table 18).

Table 18. Barrier and Facilitator Findings to Support Model dimensions

	Model for Knowledge Exchange & Utilization in Emergency Practice			Additional Findings
	Individual	Context of Practice	Knowledge	
Study I	<ul style="list-style-type: none"> -Participation in research activities - Values knowledge from multiple sources -Knowledge sharing with colleagues 	<ul style="list-style-type: none"> - Culture values knowledge - Quality initiatives (team meetings) - Visible leadership - Interorganizational networks - Accessible knowledge sources 	<ul style="list-style-type: none"> - Personal sources highly value 	<ul style="list-style-type: none"> - Structures to facilitate use of explicit knowledge
Study II	<ul style="list-style-type: none"> - Clinical Experience - Information literacy - Willingness to share knowledge - Participation in committees - Knowledge sharing with colleagues 	<ul style="list-style-type: none"> - Distractions (noise, interruptions) - Quality initiatives (journal clubs, morbidity and mortality rounds, preceptor training) - Patient flow -Intradepartmental and Intraorganizational network - Supportive culture 	<ul style="list-style-type: none"> - Availability - Complexity - Personal sources highly valued 	<ul style="list-style-type: none"> - Patient knowledge - Patient acuity - Structures to facilitate use of explicit knowledge
Study III	<ul style="list-style-type: none"> - Continuing education - Commitment to change - Clinical Experience - Knowledge sharing with colleagues 	<ul style="list-style-type: none"> -Time - Staff/patient ratio - Overcrowding: patient flow - Commitment to change - Physical resources - Intradepartmental network 	<ul style="list-style-type: none"> - Compatibility with traditional practice - Clarity of evidence - Linkage with patient outcomes 	<ul style="list-style-type: none"> - Patient preferences - Patient acuity

Individual Dimension

Individual factors have been identified in a number of studies as important for explaining knowledge exchange (He et al, 2008). A number of factors related to the individual dimension of the model were identified as important across all three studies. Differences in individual knowledge, skills, behaviors and characteristics

emerged as central to participation in knowledge exchange and utilization activities. Data converged across all three studies in relation to the importance of knowledge sharing with colleagues. The knowledge sharing behaviors of the individual clinician within and between EDs and disciplines were identified as important. In Study I knowledge sharing between nurses from other EDs was related to participation in the web based knowledge exchange intervention and items related to internal and external personal knowledge sources clustered together in the exploratory factor analysis. A strong oral tradition for knowledge exchange was also highlighted in Study II. Nurses talked about variations in the “receptivity” of individuals in their department regarding knowledge sharing. Participants in study III also identified interaction with health professionals from other EDs as relevant to changing their practice behavior. Interdisciplinary collaboration and communication is important for promoting research use in the ED (Hansen et al, 1999). Interprofessional education in healthcare is frequently used to enhance the development of practice and improve services (Hammick, Freeth, Koppel, Reeves, Barr, 2007). The preference for and importance of this activity for individual emergency clinicians provides meaningful information for researchers and administrators interested in supporting knowledge exchange. Development of structures which enhance opportunities for the exchange of best practice knowledge between individual clinicians may present as low bearing fruit that is easily accessed.

Data converged across two studies in relation to the importance of clinical experience (Study II and III) and participation in research initiatives and committee activities (Study I and II). Experiential knowledge was identified as important by nurses and physicians from study II and study III. Nurses talked about how they used their clinical experience to guide their practice and how they used the experiential knowledge of others as benchmarks for seeking knowledge sources. This is consistent with findings from other studies where nurses rely on personal clinical experience to guide practice (Gerrish et al., 2008). In addition, nurses with a larger volume of clinical experience were less likely to use other explicit knowledge sources. Physicians in Study III identified experiential knowledge as important, particularly in low volume clinical presentation scenarios. Participation in indirect care emergency experiences such as research initiatives and committee activities are important aspects of knowledge exchange. A relationship between personal involvement in research

activities and participation in a web based knowledge exchange intervention was identified in Study I ($\chi^2 = 5.234, p = .019$). An expert nurse in Study II talked about how her experience on the ED Quality committee with developing guidelines to support practice in her ED has changed her awareness of and appreciation for the use of explicit knowledge sources. She often refers to specific guidelines when sharing knowledge with other clinicians.

Context of Practice Dimension

Support for the relevance of the context of practice dimension in knowledge exchange and utilization can be seen across the three studies in this research project. This finding is consistent with other studies in the health services literature examining the importance of practice context in relation to best practice (Kitson et al 1998; Newhouse, 2007). A practice culture that values knowledge was found to influence knowledge exchange activities. Use of knowledge from multiple sources to guide clinical practice was a departmental expectation reported by the majority of rural and urban participants in Study I. However, there was a significant difference between rural and urban EDs in the expectation to use research evidence to guide practice ($Z = -3.976, P < .001$). Departmental expectation to use research evidence to guide practice was also related to participation in the web based knowledge exchange intervention ($\chi^2 = 5.521, p = .015$). Ethnographic examination of the ED in Study II revealed a strong culturally appreciation for knowledge in practice. A number of visible processes and structures were embedded in the fabric of every day practice in this department. Mentorship, preceptorship and teaching were highly visible activities, resulting in a continuous dynamic exchange of expert practice knowledge, although nurses in this department might benefit from additional preceptor support structures (ie. training, affiliation with university program). Nurses in this study also identified a number of activities specific to nursing which could enhance knowledge exchange in this ED including journal clubs and morbidity and mortality rounds.

Quality initiatives which provide opportunities for reflection in practice in ED settings are important for stimulating adherence to evidence based practice and improving patient outcomes (Blomkalns et al, 2007; Wright et al., 2008). Physicians in Study III also described the importance of a supportive practice culture which includes a visible

commitment to change and opportunities to provide input into practice change decisions. Patient care units where organizational and leadership support is high have been associated with higher use of research-based knowledge (Estabrooks, Scott, Squires, Stevens, O'Brien-Pallas, & Watt-Watson, 2008).

The importance of inter and intra organizational networks to support knowledge exchange was also an important theme running through all three studies. Knowledge exchange with clinicians from other EDs was particularly relevant in Study I and Study III. Participants in Study II (urban pediatric academic ED) also identified the importance of social networks but spoke mostly about knowledge exchange with other clinicians in their own ED or within their organization. Networks have been identified as important structures to support knowledge exchange (Russell et al, 2004; Conklin & Stolee, 2008) and emergency clinicians have demonstrated the usefulness of online networks to support the exchange of different types of knowledge (Curran et al., 2008). The Community of Practice literature also highlights the importance of social networks in knowledge exchange. Interaction between members in a community of practice creates opportunity for sharing of artifacts, stories and resources (Sanders, 2004) and contributes to a meaningful experience for practitioners as their interactions are generally tied to the context of their shared practice (Brown & Duguid, 2001). An ethnographic study revealed that primary care clinicians also worked through a community of practice and developed “mindlines” to guide practice through reflection in practice and interaction with trusted colleagues (Gabbay & le May 2004). Interorganizational knowledge sharing can be supported through online environments when adequate time is provided to participate and when the knowledge being discussed is relevant to participants (Hew & Hara, 2007)

A number of emergency practice context specific barriers were also highlighted in Study I, II and III. Emergency practice environments are known for being unpredictable and chaotic in nature. Participants in Study II and III identified issues related to patient flow as barriers to knowledge exchange. ED overcrowding was also identified as a factor in Study III. Although CTAS guidelines provide operating targets by defining patients needs for timely care, these targets are difficult to operationalize when the volume of patients is high or the number of patients with Level 1 (seen immediately), 2 (seen within 15 minutes) or 3 (seen with 30 minutes) is

high. These scenarios have resource implications which can limit adherence to best practice protocols in the ED. Particularly in scenarios such as the use of conscious sedation which requires several staff for one-on-one management. Emergency clinicians often work under time pressure constraints not experienced in other care areas. Managing multiple patients with complex needs in a compressed time period with the goal of discharge in a timely manner highlights the importance of the availability of synthesized knowledge tools.

Attention to the communication patterns of clinicians in interruptive clinical environments such as EDs has been identified as important (Parker & Coiera, 2000). Ethnographic study of the urban ED in Study II revealed the interruptive nature of the ED in relation to the physical layout of the department and the multiple demands that clinicians must attend to in an average shift. The constant flow of patients, the preference of personal knowledge sources and central location of the nursing station all contribute to a high volume of noise. The physical structure of the emergency practice environment is challenged to balance collaborative work space, patient observation and quiet space for knowledge exchange. Structures which redirect knowledge flow around the nursing station without decreasing accessibility are necessary to overcome the multiple interruptions inherent in emergency practice environments.

Knowledge Dimension

Characteristics of knowledge resources have been identified as important in other models and frameworks relevant to knowledge exchange and utilization (Rogers, 2003; Kitson et al., 1998, Greenhalgh et al., 2004). Although participants in this project acknowledged the importance of using multiple sources of knowledge to guide practice, the strong preference for personal sources of knowledge seen in Study I and II is consistent with the research literature examining sources of knowledge in practice (Bennett et al 2006; Davies, 2007). Knowledge retrieved through personal sources is faster and more specific or relevant to the clinical question than knowledge retrieved by searching explicit sources such as the internet, online journals or text books. The knowledge constructed in this manner is often strengthened with input from multiple experts. Use of personal sources also provides the added advantage of

options for probing deeper into knowledge areas that are unfamiliar to the clinician ensuring that the knowledge retrieved is customized to the clinical scenario and the knowledge needs of the seeker. A major drawback to this behavior is that clinicians rarely questioned the extent to which the knowledge shared is rooted in a strong evidence base. A similar limitation was revealed in the tacit knowledge sharing practices in primary care settings (Gabbay & le May, 2004). Another disadvantage with knowledge constructed using an oral tradition is that the constructed knowledge is not available for sharing with team members who are not present. Structures which leverage the preferred oral tradition of emergency clinicians but create opportunities to capture and make explicit shared expert clinical knowledge are needed. These knowledge exchanges structures would be particularly valuable for emergency clinicians in smaller rural EDs with limited staff skill mix.

Clinical practice guidelines were identified as important sources of expert knowledge across all three studies. Clinicians used these knowledge synthesis tools to guide their clinical decision making and validate their practice. Characteristics of the knowledge, including linkage with patient outcomes and the opportunity provide input into the development of the guideline, were identified as factors relevant to their decision use the guidelines. While other explicit sources of knowledge were available their use was limited. Nurses in Study II identified the technical language of explicit sources as a barrier for using non-personal sources. A traditional position in exploring the knowledge to practice gap is the need to present research results in an easier format so that clinicians (with less knowledge and skills) can interpret the findings. Wear (2008a) challenges this position by wondering if researchers are ignorant of the emergency clinicians' context, needs and constraints. Emergency clinicians will often choose personal sources because of the time constraints inherent in the practice setting; therefore emergency practice environments would benefit from the availability of synthesized knowledge tools in a number of formats.

Additional Findings

Two factors surfaced in this project which were not clearly identified in the original Model for Knowledge Exchange and Utilization. The first factor was the importance of structures to assist in the use of explicit knowledge sources. A range of explicit

knowledge sources are available and accessible to rural and urban emergency clinicians. However, study participants identified the need for support to use these explicit sources. Results from Study I highlight how access to explicit knowledge sources without adequate access to a librarian to support finding information may limit use of such resources. The importance of facilitators such as librarians for supporting the use of explicit sources has also been identified in the health services literature (Davies, 2007). Several nurses in Study II also suggested that summaries of research evidence prepared by their nursing colleagues would facilitate use of best practice knowledge. Two nurses interviewed reported engaging in facilitative activities such as posting best practice literature with relevant information highlighted and sharing electronic bookmarks. Reliance on interested colleagues to produce summaries of best evidence was also identified by clinicians in primary practice settings (Gabbay & le May, 2004). Facilitation was also identified as a key feature in the PARIHS framework (Rycroft-Malone et al., 2002). These types of structures may be easier to establish and maintain in larger centres, however they are also vitally important in smaller rural centres where resources are limited. Inter-organizational linkages would be vital to supporting this activity.

The second factor identified in study II and III was the importance of the patient in exploring knowledge exchange and utilization in emergency practice. First, patient knowledge was identified as an important source of knowledge to guide practice. Patients and families were also the recipients of knowledge sharing by nurses and physicians in both studies. Patient preferences were an important factor influencing knowledge utilization in rural and urban settings. When describing how they use knowledge in practice nurses commonly cited sharing knowledge with patients and families. This was a strong theme running through many of the interviews in Study II. The instrumental use of knowledge for patient education is also a prevalent theme identified in other health disciplines (Osmond, 2006). Physicians in Study III identified the importance of knowledge exchange with patients as it relates to decision making in practice. This is consistent with the medical humanism movement which seeks to include the patients' voice in clinical decision making (Hartzband & Groopman, 2009). Patient acuity can also create barriers for knowledge exchange particularly in rapidly changing situations. However, the time limits imposed when managing more acutely ill patients can be offset by the use of evidence based

algorithms, pathways or clinical decision rules. Patient knowledge and patient presentation are important considerations to be included in a model for knowledge exchange and utilization in emergency practice.

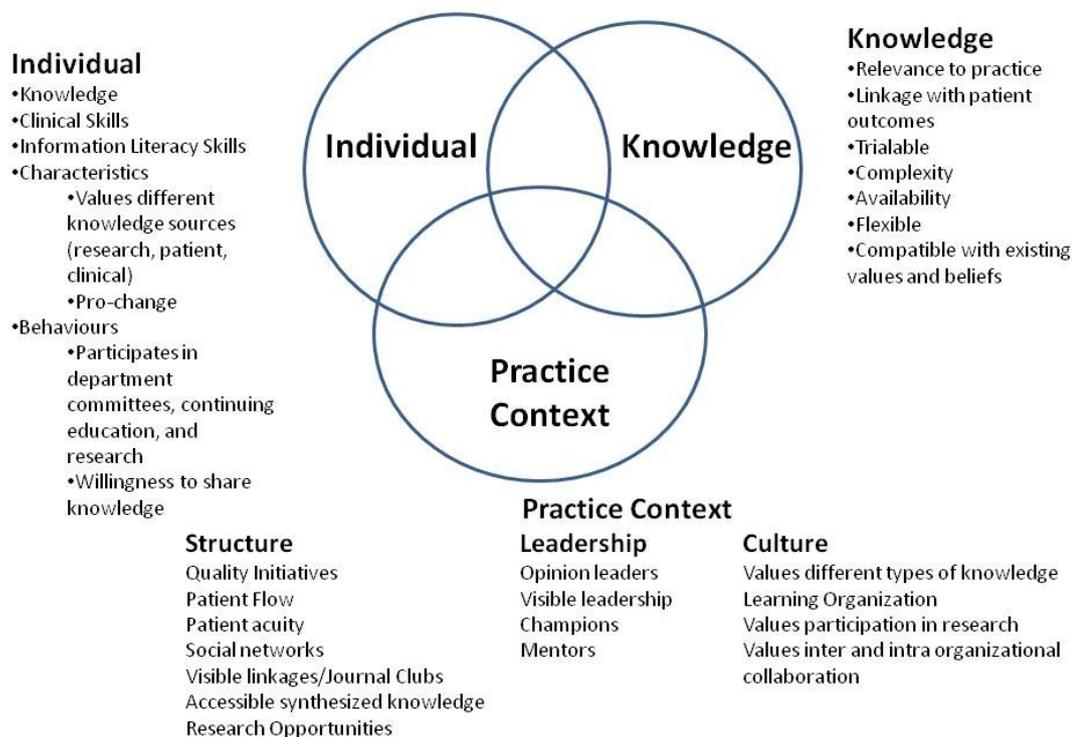
Implications

Health care organizations have identified the importance of developing and implementing conceptual models which identify barriers for moving knowledge into practice (Sudsawad, 2005; Vratny & Shriver, 2007). What distinguishes the Model for Knowledge Exchange and Utilization in Emergency Practice from other models is the focus on knowledge exchange between clinicians at the point of care. The model is intended to describe the unique knowledge exchange barriers and facilitators in emergency practice settings, where care is provided by interdisciplinary teams and patient flow and presentation are unpredictable. However, the model may provide a useful framework or starting point for describing knowledge exchange barriers at the point of care in other acute or primary care settings.

The results of this project support the notion that knowledge exchange and utilization is not a linear process, particularly in challenging practice environments such as EDs. The model diagram has been revised to reflect the nonlinear structure and the interdependency between model dimensions (Figure 3) and the barriers and facilitators unique to emergency practice settings that were identified across the three studies. The importance of inter and intra organizational networks to knowledge exchange was a consistent theme across the three studies. Further research is required to develop and evaluate asynchronous and synchronous interventions to support collaboration and facilitate knowledge exchange between and among rural and urban emergency clinicians.

This project was intended to generate new ideas and possibilities for knowledge exchange and utilization in emergency practice settings rather than truths or definite answers. The resulting model will require further exploration and refinement but may serve as a useful tool to guide future examination of knowledge exchange and utilization in emergency practice settings.

Figure 3. Revised Model for Knowledge Exchange and Utilization in Emergency Practice



Summary

Knowledge exchange in the health care literature has primarily focused on the exchange of scientific knowledge between researchers and users (Mitton et al 2007). Knowledge in practice is generally constructed through a dynamic process of sharing both explicit and tacit knowledge between individuals (Rycroft-Malone et al 2004; Sandars et al 2006). Therefore understanding intra and inter-organizational knowledge exchange in emergency practice is important for identifying opportunities to influence the construction of best practice knowledge. This project employed a mixed methods design to explore factors relevant to knowledge exchange and utilization in rural and urban EDs with the aim of developing and refining a **Model for Knowledge Exchange and Utilization in Emergency Practice**. Three dimensions were identified as important to this phenomena; *individual, practice context, knowledge*. The diversity of knowledge gained through exploring multiple perspectives in a mixed

methods design has provided a foundation for beginning to understand knowledge exchange and utilization in emergency practice. The model would benefit from further testing with larger sample sizes and a diversity of ED settings and clinical scenarios.

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Appendix A



Multidisciplinary Pediatric Emergency Care Web Based Learning Project

Dear Emergency Room Practitioner,

You are receiving this survey because you signed a consent form approximately two years ago to participate in the Multidisciplinary Pediatric Emergency Care Web Based Learning Project. We would like you to complete the attached survey regardless of the extent of your participation in the project.

Since the project began in February 2003, 12 learning modules that focused on pediatric emergency care, were presented. Eleven Emergency Departments (EDs) in rural and urban Nova Scotia participate in the project.

As a participant, your feedback is critical for planning future projects to support knowledge sharing between rural and urban EDs. We are looking for feedback from **ALL** participants who signed consents, *even those who did not actively participant in the experience*. Your responses are confidential.

Please forward your completed survey (in the sealed envelope provided) to the site coordinator at your health centre. In appreciation for your time, you will be eligible for a draw for a \$100 gift certificate to Chapters Book Store. The ED with the highest response rate will also be awarded with a \$100 gift certificate to Chapters.

If you have any questions about the survey please contact your site coordinator or Janet Curran (principal investigator) at 902-470-8788 or by email at janet.curran@iwk.nshealth.ca

Thanking you in advance,

Janet Curran
Principal Investigator,
Multidisciplinary Pediatric Emergency Care Web Based Learning Project

Multidisciplinary Pediatric Emergency Care Web Based Learning Project

1. Please indicate (✓ or X) your level of agreement with each of the following statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
I have adequate access to a library in my health care organization.				
I have access to a librarian to assist me with finding information related to emergency practice.				
I have adequate access to electronic journals in emergency care in my health care organization				
I have adequate access to paper journals in emergency care in my health care organization.				
I rely on nurses from my ED as a source of knowledge about pediatric emergency care.				
I rely on physicians from my ED as a source of knowledge about pediatric emergency care.				
I rely the Nurse Manager in my ED as a source of knowledge about pediatric emergency care.				
I rely on the Medical Director of my ED as a source of knowledge about pediatric emergency care.				
I consult with physicians from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.				
I consult with nurses from other EDs on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.				
I use paper journals on a regular basis (at least monthly) to address questions I have related to patient care.				
I use online journals on a regular basis (at least monthly) to address questions I have related to pediatric emergency care.				
I use bibliographic databases (Pubmed, Medline, CINAHL or Cochrane Library) on a regular basis (at least monthly) to find literature to address questions I have related to pediatric emergency care.				
I have adequate access to a computer with Internet options in my clinical area.				
Our ED is actively involved in research related to Emergency practice.				
Staff in our ED rely on clinical practice guidelines and protocols to guide practice.				
Over the past two years I have had adequate access to continuing education opportunities (other than this web based study) related to pediatric emergency care.				
My team usually meets on a regular basis (at least monthly) to discuss new research and knowledge or proposed changes to practice in our ED.				

Demographic Information

7. What is your professional discipline?

- Nurse Physician Social Work Pharmacist

8. What is your age?

- 20 – 25 26 – 30 31 – 35 36 - 40 41- 45
 46 – 50 51 – 55 56 – 60 61 – 65 66 – 75

11. How many total years have you worked in an Emergency Department setting?

- Less than 1 year 1 – 3 4 – 6 7 – 9 10 or more

12. What is your current employment status?

- Full time Part time % _____ Casual hours per month _____

13. In general how comfortable do you feel using a computer to access the internet?

- Very comfortable Comfortable Not comfortable

14. Please indicate if you have an active membership in the following associations:

- National Emergency Nurses Association
 College of Family Physicians of Canada [CFPC]
 Canadian Association of Emergency Physicians
 Other _____

15. Please indicate your completion of the following advanced training in Emergency Practice:

- ACLS PALS TNCC AMES
 Critical Care Course Certification in Emergency Nursing
 Certification Emergency Medicine

Thank you for your feedback!

Appendix B

Information and Authorization Form Observation Experience (Emergency Department)

Study Title: **Information Seeking and Sharing Behaviours of Nurses in
Emergency and Critical Care: A Qualitative Study**

Investigators:

Principal Investigator: Janet Curran
Child Health Clinician Scientist Trainee
Children's Health Program

Co-Investigators: Sylvia Warren
Professional Development Coordinator,
Children's Health Program

Grace MacConnell
Clinical Nurse Specialist,
Pediatric Intensive Care Unit

Shauna Best
Manager,
Pediatric Intensive Care Unit, Respiratory Therapy
& Air Medical

Introduction

You are invited to participate in a study examining the information seeking and sharing behaviors of nurses in the Emergency Department at the IWK Health Centre. It is important that you understand the purpose of the study, how it may affect you, the risks and benefits of taking part and what you will be asked to do, before you decide if you want to take part. This information and consent form will help you decide whether you would like to participate in this study. Taking part is entirely voluntary (your choice). If you have any questions that this form does not answer, the study investigators will be happy to give you further information.

Purpose of the Study

Knowledge in health care today is changing at a rapid pace. In the clinical setting knowledge is embedded in practice. Clinical experience in combination with theory and research leads to expert practice. Sharing knowledge and knowledge sources in the practice setting is essential to increasing staff capabilities and to the transfer of best practices. It is important to consider various approaches **to increase knowledge** utilization and sharing, which may impact clinical decision making of nurses.

There has been minimal exploration of the unique sources of information frequented by nurses and little attention paid to how knowledge is used in practice. This research will:

- 1) Identify the various types of information that nurses require for practice in an Emergency/Critical Care setting.
- 2) Identify the information seeking activities of nurses in Emergency/Critical Care.
- 3) Identify the knowledge sources used by nurses in Emergency/Critical Care practice settings.

The information obtained from this study may help in the design of continuing education for nurses and identify how information is structured and provided in the health care setting.

Study Design

The study is an ethnographic study design. Observation sessions will be used in both units to gather information about the characteristics and conditions of nurses, verbal communications, non-verbal communication, activities and environmental conditions. The researchers will not record any names or identifiers. Observations in these settings will require the researchers to participate in the types of activities that nurses participate in while in the practice setting. A follow up in-depth interview may be conducted with the additional consent of participants.

What Participation Involves:

Participants in this research will be observed as they provide care to patients and families and interact with their interdisciplinary colleagues. Direct observations of nursing care will be made with the consent of the nurses. There will not be any descriptive data collected about patients or families. In consultation with the participant, the investigator will identify an area in the care area that will maximize visuals and acoustics and provide the least disruption to care. A checklist will be used to guide participant observation. Each participant observation will last approximately two hours.

Field notes will be written by hand during the period of observations and expanded using a laptop during breaks or at the end of the day when details are fresh. As both of these care areas provide 24-hour care, the observations conducted will reflect the activities during this full time period. Field notes will not only reflect the observations of the researchers but their feelings and interpretations of what they saw and experienced. Researchers will also keep a journal of their experiences, theoretical ideas and analytical insights. These journals will be kept separate from the field notes and will also contribute to analysis and interpretation of findings.

A notice will be posted at the Triage desk and the Emergency Department waiting room indicating that a study is taking place in which nurses' interactions are being observed. The notice will inform families that no patient data is being captured and will give them the opportunity to notify you, the nurse, of their wish to not be observed in their interactions. The notice will clearly state that their decision will not affect the care provided to their child.

Measures will be taken to ensure confidentiality and anonymity and you will be informed of your rights as a subject in a research project. Data collected from the participant observations will be used to direct subsequent interviews with nurses. If at

any time during the participant observation, the participant (staff) or the patient/family expresses a desire for privacy or wishes to stop the participant observation process, the investigator will terminate the observation.

Results from this study will also be used in partial fulfillment of PhD requirements for the principal investigator, Janet Curran.

Potential Harms

There are no known risks to participation in this study. The competencies of the nurse will not be judged. In the event of an observation of an incident where there is a duty to report, the investigators will consult with the IWK Clinical Ethics Committee. Your decision to participate in this research will not impact your employment in any way.

Potential Benefits

The information obtained from this study may benefit nurses in the practice areas by identifying the different ways nurses obtain knowledge. This will allow educational efforts to be tailored according to the learning needs of individuals. Increased knowledge utilization will lead to an improved quality of care for patients.

Alternatives to Participation

You are not required to participate in this study. Whether or not you decide to participate in this study will not affect your employment in any way.

Withdrawal from Participation

You will be asked to read and sign a consent form in which you are advised of your right to withdraw from the study at any time without prejudice. If the study design changes in any way that may affect your decision to participate, you will be notified of the changes.

Confidentiality

All identifiable information (consents, field notes) will be stored in a locked filing cabinet. Participants' names will not appear in the researchers' notes or transcripts. All transcripts will also be kept in a locked filing cabinet in the Investigators' office. The Research Services Office of the IWK Health Centre may view the records. Records will be stored for a period of 5 years post publication. Publications or presentations on this research will not identify you personally.

Costs and Reimbursement

Participation in this study will not result in any expenses to you.

Contact Person

The investigators will be available for questions and concerns, by phone or email, from Monday to Friday 0800-1600 hrs during this study. If you have any questions about the study, at any time during or after its completion, you may contact the study investigators:

Janet Curran	470-8788 (janet.curran@iwk.nshealth.ca)
Sylvia Warren	470-8821 (sylvia.warren@iwk.nshealth.ca)
Grace MacConnell	470-6408 (grace.macconnell@iwk.nshealth.ca)
Shauna Best	470-8856 (shauna.best@iwk.nshealth.ca)

Communication of Results

The results of the research may be communicated by means of presentation(s) at workshop or conferences that will be accessible to all IWK Health Centre staff. The results of the research may also be published in one or more journal(s). Please contact the investigators if you wish to obtain a copy of the results.

Study Title: **Information Seeking and Sharing Behaviors of Nurses in Emergency and Critical Care: A Qualitative Study.**

Participant Consent

I have read this information and consent form and have had the chance to ask questions and they have been answered to my satisfaction before signing my name. I understand the nature of the study. I understand that I have the right to withdraw from the study at any time without penalty in any way. I have received a copy of the Information and Consent form for future reference. I freely agree to participate in this research study.

Name (Print) _____

Signature _____

Date: _____ Time: _____

Follow-up Interview

Would you be willing to participate in a follow-up interview?

Please initial:

Yes _____

No _____

Name (Print) _____

Signature _____

Date: _____ Time: _____

Statement by person providing information on study

I have explained the nature and demands of the research study and judge that the participant named above understands the nature and demands of the study.

Name (Print) _____

Signature _____

Date: _____ Time: _____

Statement by person obtaining consent

I have explained the nature and demands of the research study and judge that the participant named above understands that participation is voluntary and that they may withdraw at any time from participating.

Name (Print) _____

Signature _____

Date: _____ Time: _____

Appendix C

Information and Authorization Form Interview Consent (Emergency Department)

Study Title: **Information Seeking and Sharing Behaviors of Nurses in
Emergency and Critical Care: A Qualitative Study**

Investigators:

Principal Investigator: Janet Curran
Child Health Clinician Scientist Trainee
Children's Health Program

Co-Investigators: Sylvia Warren
Professional Development Coordinator,
Children's Health Program

Grace MacConnell
Clinical Nurse Specialist,
Pediatric Intensive Care Unit

Shauna Best
Manager,
Pediatric Intensive Care Unit, Respiratory Therapy
& Air Medical

Introduction

You are invited to participate in a study examining the information seeking and sharing behaviours of nurses in the Emergency Department (ED) and the Pediatric Intensive Care Unit (PICU) at the IWK Health Centre. It is important that you understand the purpose of the study, how it may affect you, the risks and benefits of taking part and what you will be asked to do, before you decide if you want to take part. This information and consent form is to help you decide whether you would like to participate in this study. Taking part is entirely voluntary (your choice). If you have any questions that this form does not answer, the study investigators will be happy to give you further information.

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There has been minimal exploration of the unique sources of information frequented by nurses and little attention paid to how knowledge is used in practice. This research

- will:
- 1) Identify the various types of information that nurses require for practice in an Emergency/Critical Care setting.
 - 2) Identify the information seeking activities of nurses in Emergency/Critical Care.
 - 3) Identify the knowledge sources used by nurses in Emergency/Critical Care practice settings.

The information obtained from this study may help in the design of continuing education for nurses and identify how information is structured and provided in the health care setting.

Study Design

The study is an ethnographic study design. Observation sessions will be used in both units to gather information about the characteristics and conditions of nurses, including their verbal communications, non-verbal communication, activities and environmental conditions. The researchers will not record any names or identifiers. Observations in these settings will require the researchers to be present during the types of activities that nurses usually participate in while in the practice setting. A follow up in-depth interview may be conducted with the additional consent of participants.

What Participation Involves

In-depth interviews will be conducted with key nursing informants from both the ED and PICU. If you agree to participate, the consent will be explained and signed by yourself and the investigator. A time and date for the interview will be arranged to accommodate the availability of the participant and provide the least disruption in care. Interviews will take place in a quiet space near the clinical areas. Interviews will last approximately 1 to 1.5 hours and will be audio recorded. The audiotape will be destroyed at the completion of the study.

A topic list will be developed based on themes identified from initial analysis of participant observation. These lists will guide the semi-structured interviews and an open ended questioning style will be employed. Questions about incidents and activities noted during the field observations will be posed in order to verify interpretations by the researcher. A purposive sample of 24 nurses (12 from each area, maximum) will be interviewed. Clinical experience of informants will include: Novice (less than one year), Competent (1 to 5 years), and Expert (greater than five years).

All necessary measures will be taken to ensure confidentiality and anonymity and you will be informed of your rights as a subject in this research project.

Results from this study will also be used in partial fulfillment of PhD requirements for the principal investigator, Janet Curran.

Potential Harms

There are no known risks to participation in this study. The competencies of the nurse will not be judged. In the event of an observation of an incident where there is a duty to report, the investigators will consult with the IWK Clinical Ethics Committee. Your decision to participate in this research will not impact your employment in any way.

Potential Benefits

The information obtained from this study may benefit nurses in the practice areas by identifying the different ways nurses obtain knowledge. This will allow educational efforts to be tailored according to the learning needs of individuals. Increased knowledge utilization will lead to an improved quality of care for patients.

Alternatives to the Study

You are not required to participate in this study. Whether or not you decide to participate in this study will not affect your employment in any way.

Withdrawal from Participation

You will be asked to read and sign a consent form in which you are advised of your right to withdraw from the study at any time without prejudice. If the study design changes in any way that may affect your decision to participate, you will be notified of the changes.

Confidentiality

All identifiable information (consents, name codes) will be stored in a locked filing cabinet in the investigator's office. Participants' names will not appear in the researchers' notes or transcripts. No descriptors will be used that will identify participants or other staff.

All transcripts will also be kept in a locked filing cabinet in the Investigators' office. The Research Services Office of the IWK Health Centre may view the records. Records will be stored for a period of 5 years post publication. Publications or presentations on this research will not identify you personally.

Costs and Reimbursement

Participation in this study will not result in any expenses to you.

Contact Person

The investigators will be available for questions and concerns, by phone or email, from Monday to Friday 0800-1600 hrs during this study. If you have any questions about the study, at any time during or after its completion, you may contact the study investigators:

Janet Curran 470-8788 (janet.curran@iwk.nshealth.ca)
Sylvia Warren 470-8821 (sylvia.warren@iwk.nshealth.ca)
Grace MacConnell 470-6408 (grace.macconnell@iwk.nshealth.ca)
Shauna Best 470-8856 (shauna.best@iwk.nshealth.ca)

Communication of Results

The results of the research may be communicated by means of public presentation(s) that will be accessible to all IWK Health Centre staff. The results of the research may also be published in one or more journal(s). Please contact the investigators if you wish to obtain a copy of the results.

Study Title: Information Seeking and Sharing Behaviours of Nurses in Emergency
and
Critical Care: A Qualitative Study.

Participant Consent

I have read this information and consent form and have had the chance to ask questions and they have been answered to my satisfaction before signing my name. I understand the nature of the study. I understand that I have the right to withdraw from the study at any time without penalty in any way. I have received a copy of the Information and Consent form for future reference. I freely agree to participate in this research study.

Name (Print) _____

Signature _____

Date: _____ Time: _____

Statement by person providing information on study

I have explained the nature and demands of the research study and judge that the participant named above understands the nature and demands of the study.

Name (Print) _____

Signature _____

Date: _____ Time: _____

Statement by person obtaining consent

I have explained the nature and demands of the research study and judge that the participant named above understands that participation is voluntary and that they may withdraw at any time from participating.

Name: (Print) _____

Signature: _____

Date: _____ Time: _____

Appendix D

Semi-Structured Interview Guide

Breaking the Ice

1. The researchers will take a few minutes at the beginning of the interview to provide a brief overview of what the interview will entail (e.g., “The next 90 minutes will be spent talking about how a typical day unfolds for you as a staff nurse in PICU/ED”).
2. Participants will be reminded that their name and the names of colleagues, patients, and families will not be transcribed.

Objectives Guiding the Researchers

1. Identifying how nursing staff in the emergency department receive and share information.
2. Identifying knowledge sources used in practice.
3. Identifying the qualities that make an information resource a good source of knowledge.
4. Identifying the barriers to using people/information resources as knowledge sources.

Possible Interview Prompts:

1. Tell me about your patient experiences during your last shift, hitting highlights from the time when you first arrive on the unit/in the department until the end of your shift.
2. Think about a recent occasion when you needed information or advice to help answer a question about a particular patient problem or issue...where did you get the information...who did you ask...if a person, why did you choose that person. (NEW)
3. The knowledge that you use in your clinical practice is based on what sources?
4. What type information do you require to practice in your setting/to provide care to your patient(s) during your shift?
5. When you have a patient- or nursing-related question that needs answering, where do you get the information/to whom do you turn for information?
6. Tell me what would be some of the barriers that would prevent you from going to a person or using a resource to get information?
7. Give me an example of a type of clinical decision you recently made and go back through the steps from when you recognized the need to make a decision to the point of making your decision?
8. What do you do to solve problems/answer questions that arise at 0300, 0900 and at 1400h?
9. How do you manage a clinical situation when you feel you do not have sufficient information?
10. What improvements in information/knowledge resources, if any, do you feel would enhance practice in your clinical area?

Appendix E

Emergency Practice Knowledge Exchange and Utilization Survey

Item	Construct	Response			
1. I have the skills necessary to critically appraise the research literature on metered dose inhalers for children with asthma	Individual	Strongly Disagree	1 2 3 4	Strongly Agree	
1b. In your estimation how relevant are the skills to critically appraise the research literature to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant	
2. I have spoken with other physicians in my ED about the use of metered dose inhalers for children with asthma	Individual	Strongly Disagree	1 2 3 4	Strongly Agree	
2b. In your estimation how relevant is your discussion about this practice with other physicians in your ED to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant	
3. I have spoken with nurses in my ED about the use of metered dose inhalers for children with asthma	Individual	Strongly Disagree	1 2 3 4	Strongly Agree	
3b In your estimation how relevant is your discussion about this practice with nurses in your ED to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant	
4. I have spoken with physicians from other EDs about the use of metered dose inhalers for children with asthma	Individual	Strongly Disagree	1 2 3 4	Strongly Agree	
4b. In your estimation how relevant is your discussion about this practice with physicians from other EDs to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant	
5. Other physicians approval of my clinical practice is important to me	Individual	Strongly Disagree	1 2 3 4	Strongly Agree	

Item	Construct	Response		
5b. In your estimation how relevant is other physicians approval about your clinical practice to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
6. I have adequate access to relevant information sources about metered dose inhalers for children with asthma in my ED	Practice Context	Strongly Disagree	1 2 3 4	Strongly Agree
6b. In your estimation how relevant is adequate access to related information sources to your use of metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
7. Our ED is committed to the use of metered dose inhalers for children with asthma	Practice Context	Strongly Disagree	1 2 3 4	Strongly Agree
7b. In your estimation how relevant is your EDs commitment to this practice to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
8. Our ED is monitoring patient outcomes for the use of metered dose inhalers for children with asthma	Practice Context	Strongly Disagree	1 2 3 4	Strongly Agree
8b. In your estimation how relevant your EDs monitoring of patient outcomes to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
9. Our ED values the use of research evidence to guide practice	Practice Context	Strongly Disagree	1 2 3 4	Strongly Agree
9b. In your estimation how relevant is your EDs value of research to guide practice to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
10. I had adequate opportunity to provide input into the decision to use metered dose inhalers for children with asthma	Practice Context	Strongly Disagree	1 2 3 4	Strongly Agree
10b. In your estimation how relevant is your opportunity to provide input on the decision to		Not at all relevant	1 2 3 4	Very Relevant

Item	Construct		Response	
change this practice to your to use metered dose inhalers for children with asthma				
11. Our ED provided adequate information to physicians about the use of metered dose inhalers for children with asthma prior to implementing the change	Practice Context	Strongly Disagree	1 2 3 4	Strongly Agree
11b. In your estimation how relevant is your EDs provision of adequate information to the physicians on the procedure to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
12. Using metered dose inhalers for children with asthma will improve patient outcomes	Innovation	Strongly Disagree	1 2 3 4	Strongly Agree
12b. In your estimation how relevant is positive patient outcomes to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
13. It is difficult to use metered dose inhalers for children with asthma in our ED	Innovation	Strongly Disagree	1 2 3 4	Strongly Agree
13b. In your estimation how relevant is the ease with which you can carry out this procedure to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
14. It is clear to me when I should use metered dose inhalers for children with asthma and when I should not.	Innovation	Strongly Disagree	1 2 3 4	Strongly Agree
14b. In your estimation how relevant is the clarity of when to use this intervention to your decision to use metered dose inhalers for children with asthma		Not at all relevant	1 2 3 4	Very Relevant
15. The guidelines for use of metered dose inhalers for children with asthma in our ED are important	Innovation	Strongly Disagree	1 2 3 4	Strongly Agree
15b. In your estimation how relevant is the importance that your EDs places on guidelines to your decision to use metered		Not at all relevant	1 2 3 4	Very Relevant

Item	Construct	Response			
dose inhalers for children with asthma					
16. Out of the last 10 children you saw with asthma in the ED with how many did you use metered dose inhalers?	0 1 2 3 4 5 6 7 8 9 10				
17. What do you see as barriers for the use of metered dose inhalers for children with asthma in your ED?					
18. What do you see as facilitators for the use of metered dose inhalers for children with asthma in your ED?					
19. On average how many shifts each month do you work in the ED					
20. How many years have you worked in an ED setting?					
21. How many other physicians work in your ED?					
22. How many physicians generally work per shift?					