University of Alberta

Exploring Medication Safety with a Restorative Approach

by

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Dedication

This work is dedicated to the participants who thoughtfully engaged in this research to explore medication safety in their hospital environment, and to nurses who work in so many ways to advance healing in health care.

Abstract

Medication safety is a key contribution to patient safety in health care settings. Health care researchers and scholars frequently report and discuss nurses' medication administration practices or medication errors associated with patients' safety in hospitals. Yet there are gaps in published reports about how practitioners view the larger phenomenon of medication safety as it unfolds on a hospital unit. Research is needed to advance our understanding of medication safety as it comes together amidst the interrelated elements in a complex hospital environment, and what practitioners identify and associate with medication safety in this context.

In this study, medication safety was explored with participants from nursing and pharmacy departments on one Canadian hospital unit. Using a restorative theoretical approach and citizen science methodology, the researcher engaged in critical conversations with practitioner and decision-maker participants (n=68) to explore elements that support and those that present barriers to medication safety through focus groups, photo walkabouts, on-unit observations, and photo elicitation. Themes from the data revealed that (1) unit structures shape medication safety, (2) medication system design affects medication safety, (3) practitioners embed accountability for medication safety into their practice and processes, (4) unit culture influences medication safety, (5) practitioners devise and employ workarounds to circumvent ongoing barriers to medication safety, and (6) participants envisioned, and in some cases implemented, restorations to improve medication safety on their unit. Findings highlight a range of contextual, interrelated supports for and barriers to

medication safety that participants discovered and shared knowledge about on their unit. Participants envisioned medication safety improvements that could be implemented at present and in the future. Workarounds, power, and possibilities for medication safety improvements related to current medication system design in health care systems are discussed.

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Chapter One

Introduction

Medication safety is recognized as an important facet of patient safety in our complex health care systems (Institute of Safe Medication Practices-Canada [ISMP-C], 2010; Macdonald, 2010). Policy makers, and practitioners who provide health care and treatment, seek to "develop mechanisms to enhance patient safety" (World Health Organization [WHO], 2008, p. 8) and patients seek safe, high quality health care for themselves and others. In this chapter, I draw from recent patient safety theory and research reports to sketch the background for this study on medication safety in a hospital setting. Safety terms germane to this study in this context are raised, and then the purpose of my research, research questions, significance of this study, and a preview of chapters to follow are outlined.

Background

Threats to patients' safety from adverse events (AEs) are explicitly outlined in an Institute of Medicine (2000) report that provided actual and projected numbers of patients injured or killed by AEs in hospitals. Healthcare researchers and scholars continue to raise awareness that patient safety in hospitals cannot be taken for granted, and patient safety is a frequently studied and discussed phenomenon (see Baker et al., 2004; Baker & Norton, 2002; Frank & Brien, 2008; Institute of Medicine, 2003; 2004; WHO, 2008). The Canadian Institute for Health Information (CIHI, 2005) reported that the rising complexity of health care for patients in hospitals "combined with the reality of limited resources creates an environment where preventable adverse events can flourish" (p. i). Researchers in

several countries assert that patients are exposed to significant risks, and many patients experience AEs associated with treatment and care in hospitals (Baker et al., 2004; Davis et al., 2001; Thomas et al., 2000; Vincent, Neal, & Woloshynowych, 2001; Wilson et al., 1995). Baker and colleagues reported they detected one or more AEs in 7.5% of patients' charts from acute medical and surgical hospitals in five Canadian provinces, indicating that one in thirteen adult patients experienced one or more AEs associated with care, based on findings from this chart review. Extrapolating from findings in Baker et al.'s study, authors of a CIHI (2004) report asserted AEs in Canadian hospitals posed serious threats to overall patient safety as "between 9,250 and 23,750 people per year experience a preventable AE and later die. This figure exceeds more than the number of Canadians who die from breast cancer, motor vehicle and transport accidents, and HIV combined" (p. 42).

These findings signal the need to explore what exists in hospital systems and processes that currently support patient safety, and to learn new ways to protect patients from preventable adverse events for people in hospitals. Several scholars have proposed ways to improve patient safety in health care (see Amalberti, Auroy, Berwick, & Barach, 2005; Braithwaite, Runciman, & Merry, 2009; Runciman et al., 2006; Wears & Cook, 2004). Wears and Cook assert patient safety advances must come from "reviewing our basic understanding of how success and failure are produced and discovering the sources of power that make health care delivery systems resilient and robust" (p. 1064).

Scholars advocate integrating patient safety into health care professional education programs to raise students' awareness about patient safety in complex health care systems (Institute of Medicine, 2003). In Canada, a collaborative of scholars created a framework of patient safety competencies outlining knowledge, skills, and attitudes for current and future health care professionals to advance patient safety (Frank & Brien, 2008). Scholars encourage inclusion of patient safety concepts in nursing education programs (Gregory, Guse, Davidson Dyck, Davis, & Russell, 2009; Gregory, Guse, Davidson Dyck, & Russell, 2007; Jones, Mayer, & Mandelkehr, 2009), in medical education programs (Alper, Rosenberg, O'Brien, Fischer, & Durning, 2009; Anderson, Thorpe, Heney, & Petersen, 2009; Singh et al., 2009; Varkey & Natt, 2007), and in pharmacist education (Hartman, 2009).

Medication Safety

Baker and colleagues' (2004) reported hospital-administered medications and fluids accounted for 23.6% of aggregated AEs that threatened patients' safety in hospitals in five Canadian provinces, and these researchers called for further studies to find ways to improve patient safety (p.1685). Since Baker et al. reported their findings, ever-increasing numbers, types, and combinations of medications have been prescribed, dispensed and administered to patients in Canadian hospitals (CIHI, 2007; Health Canada, 2010), which could signal that the number of AEs associated with medications and fluids administered to patients in hospitals may increase commensurately. Results of a recently published survey indicate 9% of Canadian adults with health problems reported that they received

the wrong medication or dose in the previous two years, and 17% of these respondents reported receiving the wrong medication or dose while in hospital (The Commonwealth Fund, 2008). The increased number and combination of medications prescribed and administered to treat patients' symptoms and illnesses in hospitals potentially threatens patients' safety. The nature of medication safety and risks associated with medications prescribed for patients in Canadian hospitals requires investigation in context where health care practitioners provide and administer and patients receive medications.

Medication regulations provide a protective framework for patients in Canadian hospitals through federal, provincial, and organizational guidelines. Health Canada, with federal authority and regulatory oversight, aims to ensure Canadians "have access to safe and effective drugs and health products" (Health Canada, Drugs and Health Products, 2009, para.1) by providing information about drugs approved for use in Canada. Provinces regulate the types of drugs that are insured and can be supplied to patients in hospitals by establishing provincial formulary committees to assess and determine which drugs will be funded for patients in hospitals. Several regional health care organizations that provide hospital services for patients in Canadian provinces established Pharmacy and Therapeutics (P&T) committees whose members monitor and regulate medications available for use, and monitor adverse medication events in each hospital (Mittman & Knowles, 2009). Policies and procedures are formulated by members of hospital P&T committees to regulate hospital medication systems and processes for practitioners who work with patients and medications. Health care

practitioners in hospitals who regularly manage medications for patients include physicians prescribing medications, pharmacists dispensing medications, and nurses administering medications as authors of a recent nursing fundamentals text describe (Potter, Perry, Ross-Kerr, & Wood, 2009).

Canadian experts assert that to achieve patient safety with medications in hospitals requires safely designed systems, appropriate equipment, and safe processes for prescription, dispensing, administration, and monitoring of medications' effects (Nigam et al., 2008; Potter et al., 2009; Saginur, Graham, Forster, Boucher, & Wells, 2008). One researcher suggests efforts are needed to develop a "universally acceptable system for measuring medication safety" (Schneider, 2002, p. 2313) as prescribed medications are "the most common intervention in health care" (Schneider et al., 2006, p. 59). Nigam and colleagues reviewed articles about medication use and developed 20 Canadian safety indicators to assess safe use of medications in a variety of settings, where "seven (indicators) relate to systems of care, 17 indicators measure a process of care, and 10 have applications outside the in-patient setting" (2008, p. 52). It would be interesting to learn how these safety indicators are applied in a health care setting, and whether decision makers or practitioners who applied any or all of these indicators found improvements to medication safety in systems, equipment and processes in a Canadian hospital, or found reduced adverse medication events.

I am interested to learn more about the nature of medication safety in complex health care systems, and about what supports or presents barriers to medication safety for practitioners and patients in hospitals. Research reports that

answered these questions were elusive, as were reports about practitioner-identified supports for and barriers to achieving medication safety at a hospital unit level where medications and fluids were ordered by physicians and administered by nurses to multiple patients. Medication safety appears to be a complex phenomenon that exists in the midst of hospital medication systems and processes, and in order to learn how practitioners view medication safety and what supports and what poses barriers to medication safety on a hospital unit, this phenomenon must be explored in context.

Safety Terms

This research to explore medication safety took place on a Canadian hospital in-patient unit. For this reason, I sought safety terms from Canadian sources of expertise in patient safety and medication safety and from theoretical and research papers to reflect upon and to consider in light of my study context.

Patient safety is defined in the Canadian Patient Safety Dictionary as "the reduction and mitigation of unsafe acts within the health-care system, as well as through the use of best practices shown to lead to optimal patient outcomes" (Davies, Hébert, & Hoffman, 2003, p. 12). A patient safety practice may be defined as "a type of process or structure whose application reduces the probability of adverse events resulting from exposure to the health care system across a range of diseases and procedures" (Shojania, Duncan, McDonald, & Wachter, 2002, p. 508). Patient safety can be threatened by "persistent and multidimensional" adverse events (Braithwaite et al., 2009, p. 37), even though system wide administrative policies, organizational practices, and technological

innovations are implemented to prevent their occurrence (CIHI, 2007). Adverse events are defined as "incidents that occur during the process of providing health care and result in patient injury or death" (Davies et al., 2003, p. 40). Adverse events are any harmful occurrences associated with health care that result in dire consequences for patients.

Iedema (2009) asserts that researchers who study patient safety in complex health care environments must consider three principles:

> First, to account for whether and how safe and improvement-oriented practice is achieved, research must engage with both the predictability and complexity of the sites and processes it seeks to describe, explain, and/or impact. Second, engaging with complexity implicates researchers in experiencing it, and this implicates the research process and its methodology in a process of sense-making of the practical and affective consequences for and with practitioners inhabiting and enacting that complexity. Third, besides numerically-based descriptions, abstracted explanations and procedural prescriptions, patient safety research evidence must encompass experiential data, collaboratively produced accounts and/or experience based designs. (p.1701)

Iedema implores researchers to explore patient safety with practitioners in the context where patient safety exists, using an interrelated approach in view of the complexities in health care environments. Researchers are challenged to take a wider view of patient safety, and to move beyond a stance where patient safety is reduced and isolated to distinct elements that are known to cause adverse events.

Medication safety is defined as "freedom from preventable harm with medication use" (ISMP-C, 2007), which raises questions about how freedom from

harm is achieved now, and what influences these efforts. Subsequently, ISMP-Canada (2009) defined harm as "a temporary or permanent impairment in body functions or structures, (impairment) includes mental, physical, sensory functions and pain". Medication safety needs to be explored to enrich our understanding of how freedom from preventable harm with medications is achieved for patients in hospital.

In the Canadian Patient Safety Dictionary, a medication error is defined as "the failure to complete a planned action as it was intended, or when an incorrect plan is used, at any point in the process of providing medications to patients" (Davis et al., 2003, p. 56). This definition is significant in that a medication error is not equated to a failure to follow a physician's medication order; rather a medication error is cited as a failure arising from an incorrect medication plan, process, or outcome for the patient. There is no reference to patient harm, or to AEs and patient suffering related to medication or a medication error included in this definition put forth by patient safety experts.

A near miss is identified as "an event that could have resulted in unwanted consequences, but did not because either by chance or through timely intervention the event did not reach the patient" (ISMP-C, 2009). Medication near misses are events where medication could have caused harm, but did not, because someone recognized the danger and averted an AE, thus what does not happen contributes to medication safety in some situations. Practitioners in health care organizations may regard medication near misses as opportunities to gain knowledge about risks to medication safety in their environment.

An adverse medication event (AME) is defined as "an injury from a medicine or lack of an intended medicine. Includes adverse drug reactions and harm from medication incidents" (ISMP-C, 2009). This definition links patient harm or AEs specifically to medications; however, none of these terms definitively portrays the nature of medication safety, nor what practitioners view as supports for and barriers to medication safety. My research purpose and research questions are therefore focused on learning more about the nature of medication safety in a hospital unit environment.

Research Purpose

My purpose in this study was to explore the phenomenon of medication safety as it exists on one patient unit in a Canadian hospital. Drawing from earlier work (Marck, Kwan, et al., 2006a) and research in progress (Marck, in press; Marck, Edwards, et al., 2006b; Marck, Higgs, Viera, & Hagedorn, 2008; Marck, Keehan, et al., 2006c), the theoretical stance of the restorative approach in health care was used to develop understanding of medication safety with practitioner and decision maker participants from nursing and pharmacy on a hospital unit. Supports for and barriers or threats to maintaining medication safety were explored, and knowledge generated with research participants was discussed and shared with participant members of the practice community during the research, as they envisioned potential safety improvements.

Research Question and Subsidiary Questions

The primary research question guiding my study was:

What are the potential supports for and threats to ensuring medication safety on an acute care hospital unit?

Subsidiary questions were:

1. How do participating nurses (Registered Nurses [RNs] and Licensed Practical Nurses [LPNs]), pharmacy workers, and decision makers describe their current system and processes with medication administration safety?
2. What elements in their present environment do participants identify as contributing to medication safety on their unit?
3. What elements in their present environment do participants associate with near misses, medication errors, preventable adverse medication events, or other medication related harms?
4. What potential supports for and threats to medication safety are observable on the participating acute care hospital unit?
5. From the knowledge generated in this study, what changes to their medication administration systems, processes, unit practices, policies, and or unit environment do participants identify as feasible and desirable to enhance medication safety?

Significance of this Study

In this exploratory study, knowledge was generated with practitioners and decision makers about medication safety on a hospital unit, and about supports for and barriers to medication safety. This research was guided by principles of the restorative approach in health care (Marck et al, 2006a; 2006b). Participants also generated and exchanged knowledge about medication safety to envision changes to improve medication safety on their work unit. This study also contributes to our understanding of the merits and limits of using a restorative theoretical approach and participatory research methods to study medication safety in the context of a hospital unit.

Summary and Preview of Next Chapters

To recap, Baker et al. (2004) found AEs threatened patients' safety in Canadian hospitals; AEs were often associated with medications and fluids prescribed and administered to treat patients' illnesses, health conditions, and symptoms. Global, federal, provincial, and regional health organization regulations offer broad safety guidelines for practitioners working with patients in hospitals and communities, and yet the nature of medication safety on a hospital unit has not been fully explored with practitioner participants to provide a contextual and interrelated approach to understand supports for and barriers to medication safety. Safety terms offer a glimpse of what patient safety and medication safety is or is not; however, these definitions are not specific to a hospital unit context. My study purpose and research questions set the stage for this exploration of medication safety with practitioner and decision maker

participants on a hospital unit using qualitative methods to develop an understanding of this phenomenon. Findings from this study contribute to our understanding of complex influences that contribute to medication safety on a Canadian hospital unit.

In chapter two, theoretical and research literature associated with medication safety on hospital units are reviewed and discussed. In chapter three, theoretical underpinnings of this study and methods used, ethical considerations, and rigor in this study are described. In chapter four, findings are presented and discussed as six themes. In chapter five, these findings are further questioned, explored and interpreted, and implications from findings which could improve medication safety in health care environments and possibly make hospital units safer places to practice, with policy, education, and research are outlined.

Chapter Two

Literature Review

In this chapter, my search strategy to locate theoretical and research literature about medication safety in hospitals is described, as are views of medication safety in hospitals offered in this literature. This reviewed literature about medication safety is presented under three broad headings: individuals' actions to attain medication safety, socio-technical means to achieve medication safety, and practice community engagement approaches to achieve medication safety. Strengths and limitations of findings and theoretical implications from this literature for my study are discussed to conclude this chapter.

Search Strategy

I searched for research and scholarly literature in electronic and library resources to find and situate my study in the context of existing knowledge about medication safety in acute and tertiary care hospital units. Electronic databases including CINAHL Plus with Full Text, Health Source: Nursing Academic Edition, Medline, PubMed, the Cochrane Library online, and grey literature of government reports and dissertations were searched using medication safety as my main search term. I combined medication safety with search terms nurses, pharmacists, pharmacy technicians, hospitals, and research, and then widened my search with search terms medication administration safety, medication administration, and hospitals.

To sort this literature for relevance to my study, I read titles and abstracts of articles published in peer reviewed journals to gain a sense of article content, and

then read articles fully to learn what has been studied and discussed about medication safety for patients on hospital units. I was most interested in study findings and theoretical conclusions situated in hospital contexts, and evaluated all articles with the following criteria: whether authors stated a theoretical framework was used, what theoretical frameworks were used or suggested to study medication safety, what methods and measures were used, whether a study was granted ethical approval, whether research questions and research purposes were identified, and how and from what populations researchers recruited samples. In research reports, I noted the sample size and conclusions drawn from a data sample, and if conclusions were credible based on the stated purpose, sample and analysis reported. In theoretical papers, I read the background provided and theory or framework constructed based on the information provided and compared these to my study setting and context.

Articles published in English, in which authors discussed or reported results pertaining to medication safety with practitioners working in acute or tertiary care hospitals, were read and evaluated for applicability to my study context. I excluded papers published in languages other than English, as I only read and comprehend English, and I excluded papers unrelated to medication safety in hospitals, such as those papers where researchers described a context outside acute or tertiary care hospitals (e.g. educational institutions, long-term care, rural, clinic, or community settings). I excluded research detailing physicians' medication prescribing choices, research providing evidence to support prescription of cancer medications for certain tumors, and randomized drugs

trials. I sought papers set in a hospital context, which contributed information about in-hospital medication safety with practitioners.

Published studies and theoretical papers meeting my inclusion criteria provided background about medication safety for patients and practitioners in hospitals. Individual articles reviewed were sorted with papers discussing similar medication safety concepts resembling the WHO (2008) priorities for patient safety research, stated as "measuring the magnitude and type of adverse events that lead to patient harm, understanding the underlying causes of harm, identifying solutions to make care safer, and evaluating the impact of solutions in real-life settings" (p. 35). Concepts apparent in reviewed literature about medication safety with practitioners in hospitals included (1) individuals are responsible for medication safety and for adverse events, (2) socio-technical interventions are implemented to improve medication safety in hospitals and (3) safety improvement is linked to engagement with members of a practice community in a hospital.

Individual Responsibility to Achieve Medication Safety

Literature in this theme contributed to knowledge about ways and means used by individuals to achieve medication safety in hospitals, which is to say individuals are responsible to administer medications safely in hospitals, and likewise, individuals make medication errors. Rather than a focus on adverse medication events, which Baker et al. (2004) identified as the key threat to medication safety for patients, most authors of this literature regarded medication errors made by practitioners as the main threat to medication safety (see Agyemang, & While, 2010), in a causal relationship. I sorted literature attributing

responsibility for medication safety to individuals' actions in a hospital environment into five areas. These areas included individual (1) nurses' perceptions of factors affecting medication administration, (2) nurses' perceptions of medication errors, (3) nurses' reporting of medication errors, (4) nurses and causes of medication errors, and (5) pharmacists' and pharmacy technicians' actions with medications.

Nurses' perceptions of factors affecting medication administration. Researchers asked individual nurses to describe their perceptions of medication administration, and found nurses used extensive knowledge about medications, patients' health conditions, and contextual factors in hospital systems to manage medication administration practice for quality and safety in three studies (Cheek, 1997; Eisenhauer, Hurley, & Dolan, 2007; Stetina, Groves, & Pafford, 2005). In one study, nurse participants pointed out contextual and structural factors such as regulations, rules, and medication resources available at work affected quality medication administration, as did professional and procedural factors including teamwork and communication, client factors, and nurses' individual medication knowledge or anxiety about making an error (Cheek). Although nurse participants did not indicate specifically what factors supported or presented barriers to medication safety, Cheek's study contributed to our knowledge that individual nurses recognized environmental factors affected safe medication administration.

Stetina and colleagues (2005) reported that nurses used their individual contextual knowledge of hospital systems and unit routines to manage medication errors. For instance if unit happenings prevented a medication from being

administered as scheduled, individual nurses administered the medication late rather than omit the medication completely. Eisenhauer et al. (2007) assessed individual nurse's thinking, which each nurse disclosed while administering medications to patients in a hospital, and argue "safe medication administration is more than a technical-mechanical process" (p. 86). Eisenhauer and colleagues assert that individual nurses do more than automatically administer medications to patients; nurse participants discussed that medication administration requires checking, coordination, and monitoring of patients' responses to medications in hospitals. In each study researchers found nurses used extensive practice knowledge about medications, patients' health conditions, and hospital systems to manage medication administration for quality and safety. Limitations to these three qualitative studies, as identified by the researchers, included that findings as interpreted and reported were limited to a view of individual nurses' thoughts and actions in response to factors while administering medications, rather than a view of how medication knowledge is shared to strengthen medication safety in the hospital or system to improve medication safety for patients.

Several authors identified that nurses pointed out factors that can adversely affect the quality and safety of medication administration in hospitals and in some cases, factors that to medication errors (see Armutlu, Foley, Surette, Belzile, & McCusker, 2008; Balas, Scott, & Rogers, 2004; Ebright, Urden, Patterson, & Chalko, 2004; Elganzouri, Standish, & Androwich, 2009; Harder & Manchester, 2007; Tang, Sheu, Yu, Wei, & Chen, 2007). Individual nurses, viewed as subjects or participants in each of these studies, reported a variety of factors and flaws in

their work environments or social support systems, which nurses associated with medication errors and near misses. Researchers in each of the above studies concluded that multiple factors influenced medication administration for nurses in acute care hospitals and that medication errors can stem from multifaceted influences rather than from one single factor. However, these researchers do not report that nurses were asked to suggest improvement strategies to address negative factors or barriers to medication safety on their units. Study limitations as reported included that four studies were conducted in one unit or hospital, suggesting findings were drawn from a small sample (Armutlu et al.; Harder & Manchester, Ebright, et al.; Tang et al.) and in three studies, data were collected using a single method, which authors suggested limit applicability of findings (Armutlu et al., Balas et al., Elganzouri et al.).

Nurses' perceptions of medication errors. Researchers have enumerated and scrutinized medication errors in hospitals for almost five decades (see for example pharmacists Barker & McConnell, 1962). In recent studies, nurses were asked by researchers to identify what constituted a medication error (Baker, 1997; Cohen, Robinson, & Mandrack, 2003; Cohen & Shastay, 2008; Tang et al., 2007). These researchers found nurses responded that medication errors occurred when any of the fundamental 'rights' of medication administration were omitted; the rights included that the right medications were administered to the right patient by the right route in the right dose at the right time for the right reason and with the right documentation. These fundamentals of medication administration are

outlined in a nursing fundamental text used in nursing education programs (Potter et al., 2009).

Researchers surveyed nurses asking if they would identify medication errors in vignettes about medication administration situations, and by so doing reveal their perceptions of what constituted a medication error (Cohen et al.; Cohen & Shastay; Hackel, Butt, & Banister, 1996; Mayo & Duncan, 2004; Osborne, Blais, & Hayes, 1999; Ulanimo, O'Leary-Kelley, & Connolly, 2007). Interestingly, nurse respondents failed to identify a medication error in several vignettes, and researchers concluded that nurses used their individual nursing knowledge and judgment to determine if and when a medication situation constituted a medication error for a patient. Researchers' cited limitations to the above quantitative self-report studies such as small sample sizes with insufficient numbers of respondents to meet power analysis requirements (Cohen et al; Mayo & Duncan; Ulanimo et al.) and study samples drawn from a single hospital that limited applicability of findings (Hackel et al., Osborne et al., Ulanimo et al.).

Nurses' reporting of medication errors. By definition, a medication error is a deviation from a standard medication process, and as such, errors are attributable to an individual. Nurses' reports of medication errors, when scrutinized, could advance knowledge of the types of medication errors reported and how nurses perceived medication errors in hospitals. Balas and colleagues (2004) found most of the nurses responding to a mailed survey reported making at least one potential or actual medication error in a 28-day self report data collection period. Many nurse respondents in Balas et al.'s study stated they had

not reported these errors or near misses to their hospital's reporting systems. Nurses employed in hospitals told researchers in other studies that they do not report all medication errors in their hospital reporting systems (Baker, 1997; Chiang & Pepper, 2006; Cohen et al., 2003; Cohen & Shastay, 2008; Elder, Brungs, Nagy, Kudel, & Render, 2008; Ferranti et al., 2008; Grasso, Rothschild, Jordan, & Jayaram, 2005; Kellogg & Havens, 2006; Schmidt & Bottoni, 2003; Ulanimo et al., 2007; Walker & Lowe, 1998). When researchers asked nurses why they did not report medication errors to hospital reporting systems, individual nurses replied they feared discipline from their employer, censure from their co-workers, or they had no expectation that reporting an error would prevent future medication errors (Chiang & Pepper; Elder et al.; Kellogg & Havens; Schmidt & Bottoni; Wakefield, Wakefield, Uden-Holden, & Blegen, 1998; Walker & Lowe). Armitage, Newell, and Wright (2007) reported that nurses who reported making a medication error in some British acute care trusts were disciplined.

Baker (1997) discovered that nurses in one hospital engaged in complex reasoning when medication situations occurred that might be interpreted as medication errors. Baker found nurses drew upon commonly held rules on their unit in which medication situations could be reinterpreted as non-errors, for instance when a situation was corrected or could be interpreted as a non-error there was no requirement for a nurse to report an error. Additionally, in two studies, researchers found nurses did not perceive that reporting a medication error was a valuable way to prevent future errors in their hospital or unit (Baker; Elder et al.). Findings from studies about individual nurses' reporting of

medication errors support the notion that medication errors, when these are viewed as human errors "arising from aberrant mental processes" (Reason, 2000, p. 768), are not reported in hospitals. If individuals or organizations rely solely on reported medication errors to address medication safety, that information is likely incomplete.

Causes of medication errors. Literature in this section seems to be based on an assumption that medication errors are the main threat to patients' safety. Some authors causes of some medication errors to individual practitioners' lack of knowledge about medications (Ebright et al., 2004; Harder & Manchester, 2007; Meurier, Vincent, & Parmer, 1997; Tang et al., 2007). Some authors reported errors were linked to nurses' lack of mathematical skills needed for medication calculations (Benner et al., 2002; Cohen et al., 2003); or nurses' lack of experience with medication administration (Ebright et al.; Manias, Aitken, & Dunning, 2005; Tang et al.). In other studies, individual practitioners' fatigue was thought to contribute to medication errors, as nurse fatigue impairs a nurse's ability to anticipate and avoid medication errors (Osborne et al., 1999; Ulanimo et al., 2007). Researchers also found medication errors linked to nurses' failure to follow hospital policy by confirming a patient's identification before administering medications (Manias et al.; Osborne et al.; Ulanimo et al.). Additionally, Tang and colleagues found nurses explained that medication errors occurred when a nurse did not clarify ambiguous medication orders with the physician who ordered the drug before administering this to a patient. Some medication errors were associated with nurses' actions as they worked around or

circumvented hospital policies or technical equipment in an effort to administer medications to patients (Koppel, Wetterneck, Telles, & Karsh, 2008; McAlearney et al., 2007; Patterson, Rogers, Chapman, & Render, 2006).

Individual nurses identified flaws in hospital work spaces and unit environments, interruptions or distractions as they administered medications, and obstructions to medication processes resulted in individuals making medication errors (see Armutlu et al., 2008; Bennett, Dawoud, & Maben, 2010; Biron, Lavoie-Tremblay, & Loiselle, 2009; Cohen & Shastay, 2008; Conrad, Fields, McNamara, Cone, & Atkins, 2010; Elganzouri, et al., 2009; Fahimi et al., 2008; Ulanimo et al., 2007). Some authors reported that nurses associated chaotic or stressful practice environments with medication errors (Balas et al., 2004; Ebright et al., 2004; Kellogg & Havens, 2006; Meurier et al., 1997). Medication errors were reported to occur more frequently when there were too few nurses working to care for patients or nursing workloads were greater than the nurses working could manage (Balas et al.; Cohen et al.; Cohen & Shastay; Kellogg & Havens; Meurier et al.; Tang et al., 2007). Blocked communication was reported as a cause of medication errors, for instance illegible hand-written medication orders by physicians were inaccurately interpreted resulting in errors (Armitage et al., 2007; Cohen et al.; Osborne et al.; Ulanimo et al.). Individual practitioners associated medication errors with malfunctioning technical equipment, for example intravenous (IV) medication administration pumps (Hackel et al., 1996; Ulanimo et al.), automated medication dispensing cabinets (Schmidt & Bottoni, 2003; Stetina et al., 2005), and bar code

scanners linked to electronic medication administration systems (Patterson, Cook, & Render, 2002).

Roughead and Semple (2009), in a review of published Australian studies about "the extent and causes of medication problems" (p. 1), stated "team, task, environmental, individual and patients factors have all been found to contribute to (medication) error" (p.6) in acute care hospitals. Regardless of causative factors researchers identified that contribute to medication errors, these errors were linked to individuals' work. Agyemang and While (2010) looked at types, causes, and impact of medication errors on individual nurses and overall nursing practice, and assert individual nurses continue to make medication errors because they do not follow procedures or lack knowledge about medication processes; therefore individual nurses should follow procedures, learn, and gain additional knowledge to avoid making medication errors.

From the literature reviewed here, it is clear that scholars looking at medication administration focused on individual nurses' perceptions of medication administration, and some authors focused entirely on medication errors. Much information was shared about individuals' reported medication errors in hospitals and the multifaceted causes of errors, although not one of these studies reported the medication errors studied were associated with patient harm, injury, or adverse events. Nurses' perceptions of medication administration safety before and after a medication safety improvement intervention were not found in this literature. Some authors recommended researchers engage practitioners to examine their medication processes to find what affects the quality or safety of medication administration

(Cheek, 1997; Ebright et al., 2004), or improve accuracy in their practice (Agyemang & While, 2010), or prevent medication errors, rather than simply identify them (Harder & Manchester, 2007; Mayo & Duncan, 2004). Researchers listed limitations in each study report, which allowed critical appraisal of findings in relation to knowledge about medication safety in hospitals.

Pharmacists and pharmacy technicians. Pharmacy practitioners in hospitals include pharmacists, who check and enter medication orders, and pharmacy technicians, who prepare and distribute medications as ordered to hospital units. In two seminal studies, Leape and colleagues (1995) and Bates and colleagues (1995) found adverse drug events (ADEs) in hospitalized patients occurred most frequently in medication ordering and administration stages of medication processes, while 11% and 14% of ADEs respectively were attributed to hospital pharmacy dispensing of medications. Flynn, Pearson, and Barker (1997) reported five hospitals' pharmacy departments had a 9% error rate in intravenous admixture compounding possibly associated with calculation errors and variations in drug concentration; of these errors, 2% could produce serious ADEs and injure patients. Errors in packaging, labeling, and repackaging of medications for unit dose distribution were detected by Oishi (2009) in a global survey of hospital pharmacy practices. In one Canadian tertiary care hospital, Turple, MacKinnon, and Davis (2006) found discrepancies in 13% of medication orders that indicated pharmacy staff had failed to provide one or more ordered medications to units for 61% of patients on 13 nursing units; these failures were each viewed as individual medication errors originating from pharmacy in this hospital.

Dispensing errors were described by one team as medication errors by individuals in a pharmacy department who failed to provide medication to hospital units as ordered (Cheung, Bouvy, & De Smet, 2009). Pharmacy staff identified dispensing errors were caused by "being busy, being short-staffed, being subject to time constraints, fatigue…interruptions during dispensing, and look-alike/sound-alike medicines" (Cheung et al., p. 677). A dispensing error can result in patient injury or death as described by Baker (2009), when medications were prepared and dispensed inappropriately from a hospital pharmacy department.

Several authors suggested ways to reduce medication errors made by individuals in pharmacy departments. Ackroyd-Stolarz, Hartnell, and MacKinnon (2005) assert improvements are needed to reduce errors and enhance medication safety, such as unit dose and automated medication dispensing systems should be implemented in hospitals, two pharmacists should check medication calculations, and interruptions should be limited for people working in pharmacy areas where medications are prepared or dispensed. A national medication safety organization suggested that even the most dedicated professionals are subject to "inattentional blindness" (ISMP, 2009, p. 1) and recommended medication preparation work areas should be distraction-free, and critical medication information should be conspicuously written on medication labels. A Canadian physician, Orser (2000) recommended lobbying drug manufacturing companies to clearly label medications in accordance with federal guidelines to reduce look-alike medication errors related to drug labeling. Nigam and colleagues (2008) recommended medication-use safety indicators should be implemented wherever medications were dispensed for patients

to prevent medication errors, such as medication reconciliation, patients' allergy status documentation, preparation and administration protocols for high risk medications, and transparent medication error reporting.

In this theme, authors report that individual practitioners in hospitals make medication errors during medication preparation, dispensing, and administration. However, authors seldom explicitly linked medication errors with adverse medication events for patients. Rasmussen (2003), in a classic paper, asserts that humans make errors, and a common response after an error occurs is to determine what the error is, who is involved, and why it happened as a causal analysis. A frequent approach to eliminate the source of a particular error is to design a socio-technical system to ensure that error does not happen again. Rasmussen points out that using a socio-technical approach can be of limited advantage when it is designed to prevent a specific error, especially when a particular error is linked to "higher order relational structures" (p. 379); a single socio-technical approach can be ineffective to achieve system improvement and error prevention in the long run. A variety of socio-technical approaches are documented that are aimed at reducing medication errors in hospitals, these are reviewed next.

Socio-technical Approaches to Improve Medication Safety

Adverse medication events happen in hospitals and threaten patients' safety. Health care decision makers in some instances sought to improve medication safety in hospitals by implementing socio-technical approaches where nurses were trained to operate technical equipment to facilitate medication administration, or educated to modify their work processes and work in new ways. One socio-technical

approach tried in health care is an adaptation of safety strategies used in aviation systems.

Aviation system safety approaches. Safety improvement efforts in health care systems can be compared to safety efforts in aviation systems, as each system is viewed as a high volume human service industry that makes use of available technology (Rutherford 2003). Rutherford asserts the aviation industry improved safety in systems by mandating that all personnel engage in safety training and use safety checklists, by monitoring reported events that could lead to mishaps, and by addressing safety issues that come to light from monitoring, to improve work processes. In health care, several researchers used similar methods to improve system safety, such as specific safety training, checklists, work redesign, or medication education sessions to improve safety in medication process points (Crimlisk, Johnstone, & Sanchez, 2009; Greengold et al., 2003; Pape, 2003; Schneider et al., 2006).

In 2003, nurse researcher Pape published a study wherein she sought ways to reduce interruptions and distractions to nurses as they administered medications; she asserts methods used in her study are based upon airline safety training and checklists. Study intervention group nurse participants attended education sessions, wore a red vest, and used medication checklists as they administered medications, as work redesign to current medication administration processes. After the training sessions, nurses in the intervention group and a control group were observed during eight medication administration passes to record the number of times nurses were interrupted. Nurses in the intervention

group were observed to have fewer interruptions than nurses administering medications on the same unit who were not in the intervention group. Pape's findings suggest this combination of training and work redesign could reduce interruptions and distractions for nurses during medication administration. Several researchers identify interruptions and distractions for nurses as risk factors for medication errors (e.g. Armutlu et al., 2008; Bennett et al., 2010; Elganzouri et al., 2009; Fahimi et al., 2008; Mayo & Duncan, 2004). Pape states the application of findings from this socio-technical approach are limited to similar nurses in similar settings using a modified case-method nursing model, and to nurses on units who do not use a dedicated room to prepare medications.

Researchers studied whether a medication education session intervention for nurses would produce an observable decrease in medication errors (Crimlisk et al., 2009; Greengold et al., 2003; Schneider et al., 2006). Crimlisk and colleagues implemented an educational workshop wherein nurses learned critical thinking and best practices to administer IV medications in one hospital, and reported IV medication errors decreased following the education session. Using a similar intervention, Greengold and colleagues studied "whether nurses 'focusing' on drug administration would have a lower [medication] error rate than general nurses" (p. 2365) after nurses who administered only scheduled medications to patients on hospital units received education about "safe medication use" (p. 2360). Greengold and colleagues, in contrast to Crimlisk et al., found that nurses who participated in the educational intervention were not observed to make fewer errors administering medications than general nurses working on the same acute

care units. Schneider and colleagues studied the effect of training sessions regarding safe medication administration for 30 nurses in three hospitals. Nurses were randomly assigned to either an educational session group or a control group with no educational session. Schneider et al. observed that some nurses who received the educational session made fewer medication errors than nurses who did not receive the educational session.

Crimlisk et al. (2009) point out that their findings do not apply to all medication errors, as they provided education and gathered data about continuous IV infusion errors and errors where patient harm was not reported on incident reports; this is reported as a study limitation. Limitations listed by Greengold et al. include that "medication nurses had relatively little training for their roles… and they did not have the opportunity to develop proficiency in their roles on the nursing units before being observed" (p. 2365). The authors referred to the purpose of their study to address this limitation, which was to determine if nurses focused on medication administration would make fewer errors than general nurses, so researchers did not want to prepare nurses artificially to administer medication and risk skewing results. Schneider et al.'s findings indicate that because of variations in individual nurses' ways of practicing, which could result in unaccounted-for differences in error rates, each nurse was treated as a unit of analysis. Therefore, medication safety for a unit was not the focus of the study; rather each individual nurse's medication practice and errors were measured.

Comparing interventions and findings in the above studies to safety strategies used in aviation systems revealed educational interventions and work

redesigns reduced interruptions in one study (Pape, 2003) and was linked to a reduction in specific reported IV medication errors in another (Crimlisk et al.2009). Findings in two studies where researchers used direct observation of nurses following an educational intervention were at best inconclusive about whether that educational intervention reduced medication errors made by nurses on study units (Greengold et al., 2003; Schneider et al., 2006). The interventions in the above studies differ from aviation system safety initiatives (Rutherford, 2003) in three ways. First, although each study focused on one area of system safety monitoring or training (around medication errors), all nursing personnel on study units did not engage in safety training about medication administration, and only one researcher introduced safety checklists (Pape, 2003). Second, a key approach used in aviation safety is monitoring safety events that lead to mishaps. Researchers in the four studies reviewed above monitored for either medication errors or interruptions after safety training, but did not mention monitoring for other safety events that could lead to mishaps. Third, researchers do not describe that medication system monitoring or interventions were implemented to improve overall medication system safety, nor suggest that educational interventions addressed medication system problems raised by practitioners on specific units. Researchers do not mention whether medication safety education or training was adopted and continued post study on study units. In four studies reviewed here, researchers monitored events reported that could or did lead to medication mishaps and errors, but did not provide information that data gathered from monitoring mishaps were used to improve medication system safety.

Root Cause Analysis (RCA). Root cause analysis is a framework used to systematically explore and analyze what happened after a complex system failure. In health care, quality and risk monitoring teams and administrators use RCA as an approach that "includes the identification of the root and contributory factors, determination of risk reduction strategies, and development of action plans along with measurement strategies to evaluate the effectiveness of the plans" (Canadian Patient Safety Institute, 2006, p. 7).

In an RCA study report, a multidisciplinary team investigated and analyzed factors that contributed to a near-fatal dose of narcotic administered to a patient enroute from an emergency department to an operating room in one hospital (Iedema, Jorm, Braithwaite, Travaglia, & Lum, 2006). By analyzing document and interview data, an RCA team determined that complex interactions led to a breakdown in patient surveillance, monitoring, and communication between health care practitioners that resulted in a severe adverse medication event (AME). Iedema and colleagues reported they had difficulty making post hoc recommendations to colleagues and peers about the need for improvement in communication and patient hand off procedures based on analysis of this medication event. Limitations to RCA as a tool to assess a systems problem or patient care failure is highlighted in this case study report: it was difficult for team members to retrospectively examine a specific occurrence and make recommendations to correct multifaceted individual practice and systems causes that came together and resulted in an AME for patient.

Researchers used RCA to detect patterns in serious AMEs by reviewing patients' in-hospital charts and investigating AMEs documented over a 29 month period in one hospital (Rex, Turnbull, Allen, Vande Voorde, & Luther, 2000). Authors here focused on the most frequently occurring causes for AMEs, which were environmental factors in the hospital or nursing unit (for instance, when the emergency room was overcapacity with patients to be admitted to hospital with increased acuity, and some of these patients were sent to inpatient units to be cared for in hallways where practitioners had no control over the number of patients for whom they were assigned to provide care), staffing issues including newly hired nurses unfamiliar with the system, or AMEs during shift change hand-overs (Rex et al., p. 564). Study authors attributed a 45% decrease in AMEs over the course of this study to process changes implemented following RCAs, including policy and staffing solutions. In these two study reports, RCAs were post hoc administrator-driven interventions to assess AMEs that were attributed to failures of safety processes during medication administration, but neither report indicated that practitioners participated in RCAs to analyze medication safety in their work processes, environment, or systems.

Failure Mode and Effects Analysis (FMEA). This systematic and proactive approach is used in automotive, chemical, aviation, nuclear power, and aerospace industries (McDermott, Mikulak, & Beauregard, 1996) to assess how and why a process or piece of equipment could fail, effects or errors resulting from a potential failure, and how potential failures could be averted. Researchers used FMEA to identify and correct error-prone processes associated with

programming IV medication pumps (equipment) in one hospital (Apkon, Leonard, Probst, DeLizio, & Vitale, 2004). In their study this team identified feasible solutions and recommended changes to correct deficiencies before medication errors could occur due to IV pump failure. The FMEA in this study was hailed as an effective socio-technical approach to detect and correct problems with function for one medication pump model at this time and place. It was not used to assess why a process or system could fail, and therefore was not expected or credited with improving overall medication safety for patients and practitioners in a hospital.

Habraken and van der Schaaf (2007) used an approach similar to FMEA to study "failed, missed and absent recovery opportunities" (p.37) in 52 reported medication errors that resulted in patient harm or death, finding that a mix of organizational and human failure factors were associated with each medication error. These authors encourage decision makers to examine accidents to learn about missed error recovery opportunities, such as times when prescribing or dispensing errors could have been identified by someone formally checking another's work. I wondered if these researchers assumed that errors could be anticipated and avoided, or if these authors were proposing that decision makers scrutinize organizational failures and correct the causes of errors.

Researchers conducted two projects using ISMP-Canada's FMEA framework in one Canadian health region (Nickerson, Jenkins, & Greenall, 2008). In one project 78 potential failures and effects of failure in medication transcription processes carried out by nurses were explored, and in the other

project team members examined 31 potential failures and effects of overcrowding in an emergency department. The research project teams created summary sheets of potential failures and related recommendations to address these, and described the unexpected positive benefit of learning about the work of other health care workers in the same organization.

Human factors engineering (HFE). This approach is used in some safety critical industries, such as designing railroads, computer interfaces for disabled individuals, and in situations where human characteristics or behaviors are considered to design or redesign workspaces or equipment to improve safety, comfort, or productivity (Norris, 2009). Technical equipment used in health care to facilitate medication dispensing or administration was designed using HFE (see Rothschild et al., 2005; Poon et al., 2008), to redesign work processes (see Bennett, Harper-Femson, Tone, & Rajomohamed, 2006; Keohane et al., 2008), and to design clear medication labels (Momtahan, Burns, Jean, Hyland, & Gabriele, 2008).

Technical devices used to deliver IV medication to patients in many hospitals are medication pumps. In three studies IV medication pumps that were redesigned using HFE, are evaluated to determine whether these pumps improved IV medication safety for nurses and patients. Rothschild and colleagues (2005) hypothesized that using redesigned "smart" IV pumps to detect IV medication errors would reduce the number of infusion-related medication errors made by nurses in one hospital (p. 533). Six months after these redesigned IV pumps were implemented, no significant difference was found in the rate of IV infusion

medication errors extracted from pump data. Rothschild and colleagues acknowledged there were many variables in their study that could not be controlled (e.g. human actions where medication pump libraries were not accessed or overridden, medications were administered IV without an order, medication boluses were given with pumps), and study limitations included evaluation of only one type of pump to assess a reduction in medication errors. The researchers concluded that introducing a single intervention (reengineered pumps) could not guarantee medication safety improvement; rather improvement in safety requires "demonstrable institutional support and behavioral improvements" (p. 538).

Researchers in two studies, one using qualitative methods (McAlearney et al., 2007) and the other with a post-implementation questionnaire (Rosenkoetter, Bowcutt, Khasanshina, Chernecky, & Wall, 2008), investigated nurses' perceptions and experiences using computerized IV pumps with decision support in their clinical practice, finding most nurses viewed the pumps redesigned using HFE favorably. McAlearney and colleagues found some nurses were concerned about aspects of IV pump design and function (e.g. IV tubing, battery life, and pump drug libraries that included drugs not used or dispensed by their pharmacy) that led them to develop "smart pump work-arounds" (McAlearney, p. 78) to overcome difficulties they encountered when operating IV medication pumps. Researchers in these two studies identified similar limitations in that each study was conducted in a single health care setting, one type of smart pump was studied, and participants may have chosen to participate based on their smart pump biases.

Using principles of HFE, researchers redesigned medication processes for prescribing, transcribing and administering medications with technology (Skibinski, White, Lin, Dong, & Wu, 2007) and redesigned medication delivery destinations on a nursing unit (Bennett et al., 2006). Skibiniski and colleagues collected data from interviews, document reviews, and observations, reporting that the new technology increased efficiency of medication order transcription, and accuracy of medication administration. Bennett and colleagues evaluated effects of changing the delivery destination on one nursing unit for unit dose medications to locked cabinets in each patient's hospital room rather than to a central location. These researchers found nurse participants evaluated medication administration was more time efficient as nurses spent less time searching for medications, and reported 64% fewer interruptions while preparing medications. The changed location for unit dose medication delivery was viewed positively by nurses as improved medication administration safety, perhaps as nurses were provided opportunities for innovation and professional development and engaged to develop the change. A limitation reported in Bennett et al.'s study was the conflict occurring on the unit as nurses' time for medication administration was reduced, although pharmacy technicians spent more time delivering medications to cabinets in patients' rooms. Skibinski et al. reported study limitations included that their study took place in only one setting, there were conflicts in the organization due to the study taking an extended time, and there was a lack of measurement for patient outcomes (AMEs) associated with the technological interventions for medication administration.

Nurses' perceptions of technological devices designed with HFE to improve medication administration have also been studied, including bar-code medication administration (BCMA) (Helmons, Wargel, & Daniels, 2009; Paoletti et al., 2007; Poon et al., 2008), electronic medication administration records (eMARs) (Keohane et al., 2008; Patterson et al., 2002; Skibinski et al., 2007; Staggers, Kobus, & Brown, 2007), an electronic system for medication reconciliation (Kramer et al., 2007) and computerized IV infusion pumps to improve medication safety (Paoletti et al., 2007; Rosenkoetter et al., 2008). Helmons and colleagues found the number of observed medication administration errors on medical and surgical units in one hospital decreased following BCMA implementation, but a decrease in errors was not observed in critical care units. Paoletti and colleagues reported a statistically significant reduction in observed medication errors on two nursing units after a suite of technological, educational, and work process interventions for medication administration were implemented. Poon and colleagues found that following BCMA implementation in one hospital, nurses who were observed did not spend significantly more time administering medications with the new technology, than they did before BCMA. Rosenkoetter and colleagues reported that nurses in one tertiary care hospital perceived technologically enhanced IV pumps increased medication administration safety. Keohane and colleagues (2008) observed the amount of time that nurses spent on medication administration activities before and after implementation of BCMA and eMAR technology, reporting that after implementation nurses spent less time

transcribing and signing paper based medication administration records, but more time waiting for access to and logging onto electronic devices.

Staggers and colleagues (2007) explored a sample of Navy nurses' perceptions about the usability of newly designed eMARs, finding nurses were satisfied with eMAR implementation following extensive investigation, trials and support. However, authors did not report if nurses perceived new eMARs improved medication safety. Skibinski and colleagues (2007) interviewed practitioners in one hospital and monitored medication error rates to assess the effects of a new pharmacy computer system, new automated dispensing cabinets, and point of care medication technology. Some respondents identified new medication safety concerns and ways to work around eMAR technology; however, medication error rates remained unchanged. Patterson and colleagues (2002) used ethnographic methods to investigate nurses' perceptions of unfavorable aspects of BCMA in a redesigned medication system. Nurses identified that "new paths to failure" turned up in their medication administration system (Patterson et al., p. 541); for example, nurses identified instances of "poor usability" and "automation surprises" (p. 547) when medications disappeared from electronic medication profiles in redesigned systems, although these medications were not discontinued. Practitioners in this study stated they needed to be extra vigilant for AEs associated with redesigned processes or technical equipment. In contrast, Kramer and colleagues (2007) found that technology enhanced patient discharge teaching about medications. In their study, nurses and pharmacists collaborated to complete electronically generated patient medication

reconciliation forms, and provided patients with a printed list of current medications on discharge, which could enhance medication safety for patients.

Saginur and colleagues (2008) surveyed Canadian hospitals, and found that most pharmacy departments used technology to support medication safety, most often through pharmacy order entry systems, IV admixture services, unit dose drug distribution systems, and computerized MARs. Few pharmacy departments adopted bar coding of medications, computerized physician order entry, or automated drug dispensing cabinets. These authors did not include an assessment of whether currently used technology actually supported medication safety or reduced medication errors.

In each study reviewed in this theme, socio-technological approaches were implemented, tested, or evaluated to assess medication safety improvement in acute care hospitals. Medication safety improvement was most often measured by studying a single safety indicator (e.g. medication error rate), sometimes with inconclusive results (e.g. Greengold et al. 2003; Rothschild et al., 2005). In one Canadian study, authors reported that nurses working on an acute care hospital unit participated in assessing the feasibility of changing the medication delivery process, and then evaluated the changed process as a successful medication safety improvement (Bennett et al., 2006).

Community Engagement Approaches to Medication Safety

Several scholars recommend a systems approach to improve medication safety or prevent errors rather than using a single intervention such as education, technology, or equipment redesign (Anderson & Webster, 2001; Barach &

Johnson, 2007; Classen & Metzger, 2003; Rasmussen, 2003). With a systems approach, practitioners collaborate to "see whole systems and any counter intuitive linkages within them [and] expose processes to mapping, analysis, and redesign" (Clark et al., 2004, p. 86). Research where practitioners are engaged to examine medication safety in hospital systems are reviewed in this section.

Safety culture. The National Steering Committee on Patient Safety in Canada (2002) recommends that people in health care organizations establish a safety culture with shared beliefs and common goals for safe patient care. Dennison (2007) hypothesized that medication safety culture on one nursing unit would improve following implementation of a single technology-enhanced educational intervention to reduce harm to patients from IV medication errors. Dennison noted there was a statistically significant change in nurse participants' knowledge about medication errors, but no change in medication safety climate scores detected with the scales used. This researcher concluded that barriers to improved medication safety climate were embedded in hospital systems, where deficiencies existed such as heavy nursing workloads, task or interaction complexity, practitioners' constrained ability to adapt to change, or a lack of organizational support and leadership. Limitations in this study included incomplete participation of nurses on the study unit (20 out of 31), and use of a single intervention in an attempt to change safety culture.

In a study designed to raise awareness of organizational culture and identify ways to improve patient safety during medication administration with nurses working in one hospital, McBride-Henry and Foureur (2006) triangulated results

obtained from surveys, focus groups, and nurses' clinical practice groups. Most study participants indicated they became aware of medication safety as they identified barriers to medication safety in their system, and some nurse participants stated they were "powerless" to improve medication safety on their unit (p. 221). After single intervention practice development projects were implemented in the hospital, a quantifiable change to medication safety culture was not detected. McBride-Henry and Foureur (2007) asked staff nurses to articulate what they perceived made them feel safe or unsafe with medication administration, and what systems issues affected medication administration, using a safety climate survey, focus and practice development groups. Nurses responded that a supportive medication safety culture included team members working well together with good communication, and a "working knowledge of medications" (p. 62). Some nurses identified that unsafe nurse staffing levels did not support safe practice and could precipitate medication errors. These authors assert that their research led to "a review of medication administration policies, a focus on enhancing relationships within multi-disciplinary teams, and hospital wide education sessions about medication safety" and concluded "the safety culture within an organization has a significant impact on how errors and safety related issues are addressed" (McBride-Henry & Foureur, p. 64). Authors assert study limitations include that the study was conducted in one hospital with a variety rather than a random sample of nurses, so "findings we present here are not generalizable" (p. 65).

Fogarty and McKeon (2006) also surveyed nurses finding that when organizational climate (culture) was perceived positively, nurses reported feeling less stress, had fewer violations of hospital procedures, or made fewer medication errors than if climate was not perceived positively. These researchers concluded that organizational climate affected medication errors and nurses' procedural violations with medications and could "force nurses to cut corners" (p. 455). Study limitations identified by Fogarty and McKeon included ambiguity in some survey questions which did not clearly link safety climate to medication administration. Fogarty and McKeon concluded "organizational culture is too broad a construct to account for large variations in medication safety" (p. 454).

To support a medication safety culture in the pharmacy department, a "tech check tech" (Van, 2007, p.1) process was tried, whereby pharmacy technicians checked accuracy of other technicians' medication preparation and unit dose medication distribution. Two studies evaluated that pharmacy technicians' accuracy in checking was comparable to accuracy of pharmacists' checking (Ambrose et al., 2002; Andersen, St. Peter, Macres, & St. Peter, 1997), increasing participants' confidence, esprit de corps in pharmacy, and improving safety culture.

Community engagement to improve medication safety. Marck and colleagues (2006a) adapted principles and methods from the field of ecological restoration, which is the study and repair of ecosystems which have been degraded, damaged, or destroyed (Society of Ecological Restoration International, 2004; Higgs, 1997; 2003), to study medication safety with nurses, a pharmacist,

managers, and medical and nursing leaders on a medical unit in a hospital. Using a unit medication safety survey (n = 12), practitioner-led photographic walkabouts of the unit, focus groups with the patient care team (n = 20), and medication process mapping to generate understanding of medication safety in the setting, participants and researchers used the findings along with published Canadian guidelines on medication safety (ISMP-C, 2007) to collaboratively design targeted improvements. Team members implemented revised orientation information for new staff, a debriefing practice after errors and near misses to prevent future errors, a clean-up of medication areas and revisions to the narcotic delivery schedule, revised documentation procedures, and the use of research photos to provide visual aids to staff regarding the expected organization of the narcotic cupboard. The strengths of this research approach included the participation of practitioners in exchanging knowledge about medication safety with managers, educators and researchers on the research team, the collaborative approach to the design and conduct of the research, and the engaged participation of staff in data collection, data analysis, and dissemination of findings. Limitations to Marck et al.'s study included that it was conducted on a single hospital unit without studying a comparable hospital unit as a control to compare improvements over time, and the survey results were drawn from a small sample.

Two studies reported practicing nurses were asked to assess medication safety in their hospital workplaces (Marck et al., 2006a; McBride-Henry & Foureur, 2007). In Marck et al.'s study, practitioners translated their knowledge from assessments into action to correct unsafe areas in systems and processes.

Results from these two studies illuminated advantages of practitioner engagement in explorations of their work systems and processes and generation of knowledge about medication safety in practice settings. Using the restorative approach in health care, Marck et al. supported practitioners to translate their new knowledge to improve medication safety.

Nurses' perceptions of patient safety, medication safety, and medication reconciliation practices were studied in one Canadian hospital (Chevalier, Parker, MacKinnon, & Sketris, 2006). Nurses identified teamwork within units as most supportive of patients and medication safety, while information transfers during handoffs, and poor communication between healthcare professionals were least supportive of medication safety. Participants recommended improvement in information exchanges during patient handoffs, and researchers reported medication reconciliation procedures were implemented soon after this study.

Clinical pharmacists working collaboratively with other practitioners on hospital and emergency departments are credited with improving medication safety culture for patients and practitioners in two studies (Brown et al., 2008; Vermeulen et al., 2007). Vermeulen and colleagues developed a "high performance pharmacy practice framework" (p. 1699) which credits improved medication use processes with constant communication about patients' medications between nurses and pharmacists, nurses and pharmacy technicians, and pharmacists and pharmacy technicians on a hospital unit Brown and colleagues found that pharmacists working side by side with practitioners in an emergency department offered clinical advice about appropriate medications and

dosages and the work of these clinical pharmacists was cited as the reason for a reduced number of medication errors in physician orders and nurses' administration of medications. Medication safety was improved by knowledge exchanges and camaraderie of health care professionals working together not just by reducing the number of medication errors.

Summary of Learning about Medication Safety from Literature Reviewed

Literature reviewed here illustrated that authors conceptualized and discussed medication safety from different viewpoints. In the first theme, individual nurses and their medication administration processes are scrutinized and although several environmental factors were found to influence medication administration, nurses are often found responsible for medication errors. Practitioners (nurses, pharmacists, and pharmacist technicians) are mostly studied as subjects, not participants, and observed or surveyed to ascertain what they individually were doing to achieve medication safety in a complex hospital setting. Literature reviewed in the second theme included studies where attempts were made by decision makers to implement technology or training solutions to fix medication safety problems with socio-technical approaches. In most instances the socio-technical adjustment was directed at correcting medication errors associated with equipment malfunction or a medication process segment, rather than approaching medication safety from a systems perspective. In the third theme, once again medication safety was studied, and some authors attempted to improve medication safety by engaging practitioners as practice community members to identify and test improvement initiatives in their environments, and

exchange knowledge with fellow practitioners along the way. The authors in the third theme reported the most success with several medication safety improvement initiatives. The strength and limitations of findings in this literature associated with medication safety in context of my study are examined next.

Strength of findings. Literature and studies reviewed in the first theme suggest that in acute care hospitals, medication processes are multifaceted and carried out in complex systems. Researchers found nurses' practice with medication administration in hospitals was affected by contextual and structural factors, professional and procedural factors, patients' conditions and nurses' knowledge (Cheek, 1997; Eisenhauer et al; 2007; Stetina et al, 2005). Interestingly, several researchers recommend further research where practitioners are engaged locally to examine medication systems and processes in their workplaces to gain an understanding of what affects medication safety (Cheek; Ebright et al., 2004; Osborne et al., 1999; Walker & Lowe, 1998).

Medication errors in hospitals are studied extensively using a variety of methods and perspectives, providing incontrovertible evidence that medication errors occur, although all errors might not be regarded or reported as such by nurses, pharmacists, or pharmacy technicians in acute care hospitals. Researchers found scores of factors could cause or precipitate medication errors in hospitals, such as flaws in systems, processes, and social support structures in work environments (e.g. Armutlu, et al., 2008; Balas et al., 2004; Ebright et al., 2004; Osborne et al. 1999; Ulanimo et al., 2007; Tang et al., 2007). Based on their findings, researchers recommend research to find ways to prevent medication errors

for nurses and practitioners in pharmacy, improve medication safety, and identify solutions to make hospital care safer, although medication safety per se was not explored in hospitals in this theme.

In studies reviewed in the second theme, researchers sought evidence of medication safety improvement following a socio-technical intervention; most often this included an educational session or technical equipment redesign. Results were mixed. Evidence of medication safety improvement was reported by two research teams as fewer medication errors were recorded post- interventions (Paoletti et al., 2007; Schneider et al., 2006). Process redesign reduced the amount of time to administer medications by nurses in three studies (Bennett et al., 2006; Keohane et al., 2008; Poon et al., 2008), these interventions were viewed as medication safety improvements, as were reports of technical interventions regarded positively by practitioners, such as eMARs (Staggers et al. 2007). One researcher implemented an intervention modeled on aviation safety and reported fewer interruptions to nurses during medication administration passes on one nursing unit (Pape, 2003).

Re-engineered technical equipment (e.g. smart IV pumps) or educational programs failed to improve or did not demonstrate measurable changes to medication safety (Dennison, 2007; Greengold et al., 2003; Patterson et al., 2002; Rothschild et al., 2005; Schneider et al., 2006). Researchers reported nurses sometimes developed workarounds (e.g. McAlearney et al., 2007) after technical medication equipment was implemented. When this contrasting evidence was viewed overall, questions arose about the nature of medication safety for people in hospitals. How is medication safety viewed at present and how do practitioners

envision improvements to medication safety on a hospital unit? Is medication safety improved overall with incremental socio-technical interventions to combat individual medication errors or new drugs and treatment combinations for patients in hospitals, or were these interventions viewed as barriers that must be worked around? Do researchers who look for medication errors find them, while medication errors persist?

Rather than focusing solely on socio-technical levers for change, some researchers studied organizational safety culture or involved "operators" (Schein, 1996, p. 9), as those individuals (e.g. nurses) directly involved with the phenomenon to examine medication processes and systems. Some researchers asked practitioners to identify medication safety culture, safe and unsafe areas, or ways to improve medication safety in their work environment (Bennett et al., 2006; Marck et al., 2006a; McBride-Henry & Foureur, 2007; Vermeulen et al., 2007). Two Canadian studies indicated that nurses and one Canadian study identified that pharmacists identified supports and barriers to medication safety on their hospital unit, and researchers reported changes initiated in collaboration with practitioners in their work environments were evaluated as medication safety improvements (Marck et al.; Bennett et al.; Saginur et al., 2008).

Limits of these findings. The most striking limitation in reviewed this literature was the scarcity of reported studies where researchers explored medication safety as a unique phenomenon in a hospital setting with practitioners. Few researchers reported they involved practitioners in their hospital work environment to explore the nature of, supports for, or barriers to medication

safety. Noticeably sparse were studies where researchers reported that they asked practitioners what they suggested to improve medication safety in their workplace, or even what safety interventions they suggested to reduce medication error occurrences.

Given the preponderance of studies focused on nurses' medication administration and medication errors, researchers were mostly silent in studies reviewed about linking harm to medication errors, even as Baker et al. (2004) reported 23.6% of AEs were related to medications and fluids patients received in hospital. Also, there are a variety of medication error definitions provided, although a medication error definition was not located that linked patient harm to medication errors. If a link between medication errors and harm is firmly established, perhaps researchers could find ways to avert harm from those medication errors as a way to improve medication safety. In view of these gaps, it is hard to believe that eradicating medication errors or procedural violations will achieve medication safety defined as "freedom from preventable harm with medication use" (ISMP-C, 2007).

Findings from studies where there was a single intervention targeted at reducing interruptions to nurses (such as Pape, 2003) or reducing medication errors by work redesign (such as Crimlisk et al., 2009) were often based on evaluation of a single indicator rather than overall medication system safety improvements. In several studies a redesigned process or equipment was implemented and researchers reported cause-and-effect evidence from a changed process or equipment (see Pape; Schneider et al., 2006). However, in a complex

system, one change in medication process or equipment does not guarantee overall medication safety improvement, as a change often requires adaptations in other elements of complex systems (Plesk & Greenhalgh, 2001). Some researchers recognized that implementing technical equipment for medication administration coincided with equipment workarounds (see Koppel et al., 2008; McAlearney et al., 2007). Although several researchers asserted their research goal was to improve medication safety in a particular setting, only a few researchers (see Marck et al., 2006a) indicated that education and training sessions intended to improve medication safety were continued post study.

There is limited evidence of medication safety improvement from studies focused on organizational culture. Some researchers suggested it is difficult to detect changes in medication safety culture after interventions using instruments chosen in their studies (Dennison, 2007; Fogarty & McKeon, 2007; McBride-Henry, & Foureur, 2006). Other researchers asserted collecting self report data limited their findings (e.g. Armutlu et al., 2008; Balas et al., 2004; Cohen et al., 2003; Cohen & Shastay, 2008), and suggested that in order to obtain more valid and reliable findings, researchers should use multiple methods of data collection and triangulate findings, as suggested by nurse researchers Loiselle, Profetto-McGrath, Polit, and Beck (2007).

There were limitations to findings from studies reviewed where researchers engaged nurses to assess or implement medication safety improvements. Limitations include small self-volunteering samples of nurse participants, and safety improvements that were assessed by within-unit or within-hospital

measures, without comparison or control groups (Bennett et al., 2006; Marck et al., 2006a; McBride-Henry & Foureur, 2007). These limitations restrict an appreciation of the magnitude of improvement to medication safety realized, and suggest a need to explore medication safety in other hospital settings with practitioners who work with medications.

Theoretical and research implications of findings. Research based on a theoretical approach, such as a systems approach, is recommended by scholars to study health care system improvements. Theory provides a framework to consider the effectiveness of improvement strategies (Eccles, Grimshaw, Walker, Johnston, & Pitts, 2005). A theoretical framework with explicitly stated assumptions can assist research consumers to distinguish between theories that support systems improvement and those that do not, and perhaps prevent researchers from overlooking key components of an effective improvement program (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidiou, 2004; Grol, Bosch, Hulscher, Eccles, & Wensing, 2007). In literature reviewed here, several authors asserted that interventions were based on a particular systems approach (e.g. aviation system safety interventions, RCA, FMEA, or HFE). In one reviewed study, it was clearly articulated that researchers developed a theoretical framework to guide the study (Marck et al., 2006a) from design to evaluation.

Research implications from the reviewed literature are complex. I appreciated reading about the variety of study approaches, purposes, methods and findings focused on medication administration and medication errors in acute care hospitals. However, with the exception of Marck et al. (2006a), there is a gap in

research that actively engages practitioners to focus on medication safety in their acute or tertiary care hospital work environments. Most researchers did not report working with practitioners to explore medication safety in their medication practice or system. Arguably, such an approach is needed to assess medication safety in hospitals and systems.

Several researchers focused on evaluating a change in the number of reported or observed medication errors. The research implication from this stance is that errors are the primary threat to medication safety for patients, and that all medication errors are reported and detected. I questioned these assumptions, as several researchers report that all medication errors are not reported (e.g. Baker, 1997; Grasso et al., 2005), and there is a paucity of studies that link specific errors to specific AEs. Researchers in a few studies (Bennett et al., 2006; Keohane et al., 2008; Paoletti et al., 2007; Pape, 2003; Poon et al., 2008) suggest medication safety for nurses practicing in hospitals improved following an intervention with a process or system component, rather than a whole system. In two studies, researchers reported improvements to medication safety for nurses achieved with interventions devised and implemented by and with nurse participants (Bennett et al., 2006; Marck et al., 2006a).

Findings from Marck et al. (2006a) indicate that practitioners on one hospital unit collaborated with researchers to actively study medication safety issues and implement specific practices and improvements to strengthen medication safety. While findings from a single study do not guarantee improvements to medication safety elsewhere, these findings suggest there is

potential for further studies using a restorative research approach to engage practitioners to use their local knowledge to explore safety in their practice environments with this theoretical approach. The purpose of my research is therefore to use a restorative approach to explore medication safety with nurses and pharmacy workers on a hospital unit.

In the next chapter, I discuss the theoretical framework, methodology, and methods used in my study. Measures taken to maintain rigor in my study and ethical permissions are discussed.

Chapter Three

Methodology

My aim in this chapter is to provide the reader with a clear understanding of the research processes I employed to explore the nature of medication safety on a hospital unit. First I outline the methodological perspective and theoretical assumptions which underpin my research approach, and then the research methods chosen to answer my research questions are described. Methods include sampling, the study context, recruitment of participants, and data collection and analysis as an iterative process. My provisions to support rigor in this study and with each research method are discussed, as are ethical considerations and potential study limitations with my actions to address these. I concluded this chapter with my plan for knowledge sharing and exchange.

A Restorative Research Approach in Health Care: Methodological Considerations

The methodological lens that informed this research was the restorative approach in health care research developed by Marck and colleagues (Marck, in press; Marck et al., 2008; Marck et al., 2006a; 2006b; Marck, 2006; 2005; 2004a; 2004b). This socio-ecological perspective on health systems draws on the fields of nursing (Marck, 2006; Marck et al., 2006a; 2006b; 2006c), health care ethics (Marck, 2004, 2000b), ecological restoration (Higgs, 2005, 2003, 1997), and adaptive ecosystems management (Gunderson & Holling, 2001; Gunderson, Holling & Light; 1995). Marck et al (2006b) assert that the restorative approach in health care research is an appropriate framework "to study and strengthen the

safety of healthcare environments within complex technological health systems" (p. 3). Ecological restoration is defined as "intentional activity to study and assist the recovery of an ecosystem, with respect to its health, integrity and sustainability" (Society for Ecological Restoration International Science and Policy Working Group, 2004, p. 1). The theoretical assumptions from ecological restoration that informed this study are:

1. ecosystems are viewed as a form of complex adaptive system (CAS) whose conditions reflect the way that we treat each other and the places we inhabit (Higgs, 1997); and
2. good ecological restoration of damaged environments and ecosystems requires attention to both ecological integrity and the health and integrity of "historical, social, cultural, political, aesthetic, and moral aspects" (Higgs, 1997, p. 338) of a place, and therefore, attention to the community's relationship with the place they share.

For the purpose of this research, complex adaptive systems (CAS) were viewed as closely coupled social-ecological systems (SES) where people interacted in non linear ways with others (social) and with their environment (ecological), with their immediate environment being nested within a larger, evolving living system that is constantly adapting and changing (Anderson, Crabtree, Steele, & McDaniel, 2005). Enacting good ecological restoration therefore requires researchers to consider the complex interplay between a wide variety of social and ecological phenomena within a given ecosystem. Thus, focusing on a single aspect of a phenomenon within a CAS can preclude the

development of a robust understanding about the phenomenon. The socio-ecological perspective on CAS that informed this study included assumptions that:

1. health systems are characterized as a form of CAS where people in communities (such as hospitals and hospital units), and their environments continually co-evolve, shape each other, and adapt in a variety of ways which are not always predictable (Alessa et al., 2009; Marck, 2006; Marck et al., 2006b; Young et al. 2006);
2. the multifaceted ways in which people and their environments shape each other within health systems requires researchers to seek a variety of data sources to uncover attributes and linkages between aspects of a phenomenon. These data sources include local experts who are involved in that health system community to explore the nature of phenomena within a hospital environment.

In the restorative theoretical approach that Marck and colleagues developed, health care systems are viewed as CAS whose prudent management requires "ongoing cycles of research, practice, adaptation, and evaluation to effectively evolve, adapt and renew over time" (Marck et al., 2006b, p. 3). Within a view of health systems as CAS, ongoing complex interactions within and between all systems levels are considered to be shaped by a range of influences (e.g. ethical, historical, cultural, political, economic, biological, and technological) that comprise the social and ecological integrity of our world (Marck, 2004, 2006; Marck et al., 2006a, 2006b).

Present day healthcare systems are described as CAS by several researchers advocating for a variety of systems approaches to study issues in health care environments (Anderson, et al., 2005; Anderson, Issel, & McDaniel, 2003; Clancy, Delaney, Morrison, & Gunn, 2006; Edwards, Marck, Virani, Davies, & Rowan, 2007; Glouberman, 2001; Marck et al., 2006a; McDaniel, Jordan, & Fleeman, 2003). For instance, researchers have used CAS thinking to study how a community's water supply was contaminated with lethal bacteria (Ali, 2004; Glouberman), and to ascertain how patient outcomes improved in several nursing homes when practitioners engaged in participative decision making (Anderson et al., 2003). In these particular studies, researchers conceptualized health care systems as CAS from a socio-technical perspective of health care environments. In this socio-technical view of health systems as CAS, human agents engage in individual processes to exchange information; there are non-linear connections between agents; systems self-organize and co-evolve in response to changes; and system properties emerge as agents respond in ways that are not fully predictable (Anderson et al., 2003; Stroebel et al., 2005). Researchers illuminated that adopting a CAS perspective in the above studies positioned them to apprehend what was actually happening in the environment as the foreground for consideration, rather than attempting to implement solutions in a complex system in a reactive manner, or focusing on an individual cause or problem that demanded a single corrective solution.

Marck and colleagues (2006a) acknowledge the importance of socio-technical aspects of complexity thinking, and they also argue that we could learn

more about the management of health care systems as CAS if we consider potential parallels between how we manage (or mis-manage) ecosystems and how we manage (or mis-manage) other CAS, including health systems (Marck, in press; 2006; 2005). These arguments stem from reviews of ecosystems management research where the term 'complex adaptive systems' is often used interchangeably with the term 'socio-ecological systems' to study such phenomena as transitions to adaptive governance in social-ecological systems (Olsson et al, 2006), and the "problem of fit" between management strategies used with ecosystems and those used with human institutions (Folke, Pritchard, Berkes, Colding, & Svedin, 2007, p. 1).

Marck and colleagues argue that the restorative approach in health care research does not limit the analysis of safety and quality issues within complex healthcare environments to the actions of various agents within organizations (P. Marck, personal communication, August 29, 2008; Marck et al., 2006a). For Marck and colleagues, the principles of a restorative approach to health care research at this juncture also integrate four key elements: a place ethic, engaged practice, adaptive learning and growth, and citizen science (Marck, in press; Marck et al, 2008; 2006b). For these researchers, the concept of place ethics stems from earlier work in environmental writing on place awareness (Buell, 1995) and work on the meaning of place in restoration (Higgs, 1997). Place ethics calls for people, including researchers, to acknowledge and respect the history, culture, knowledge and rituals that exist in a shared place (Marck, in press; Marck et al, 2008). Thus, a place ethic is visible in the way people treat each other (for

example, supporting one another) while caring for the place they share; it is also evident in their actions, as they show what they value as they care for their environment.

Buell (1995) argues that the way people respect and build on historical knowledge is embodied within their shared place. Higgs (2003, 1997) asserts that respecting a shared place involves respect for the inhabitants' shared history, culture, knowledge and rituals. Marck (2004) drew from work about caring for place by Leopold (1949), Buell (1996), and Higgs (1997) to point out that for many practitioners, their health care work unit is a home place whose integrity, relationships, and conditions matter greatly. This claim seems evident in many workplaces where practitioners take visible pride in being part of a place or unit where they strive to provide safe, high quality care to patients. This observation led Marck and colleagues to assert "vital connections between the culture and ecology of a community are fundamental to the conditions for good restoration" (2006b, p. 20), in health care or in other parts of our world.

A second element of the restorative approach in health care research, engaged practice, refers to the idea that people need to actively connect with each other and the place they share to understand and achieve lasting system improvements (Marck, 2006, p. 13). When health care practitioners engage in critical examination of their systems and practices, it is argued, they can identify practices and processes that support and strengthen safe care and also recognize those areas in need of repair to improve safety. Marck et al. (2006b) describe this element of the restorative research approach as "We create safe places (we

successfully enact an ethic of place) and safer systems (we monitor and manage health systems through the conduct of citizen science) when we engage health care communities in joint journeys of research-informed practice" (p. 23). Through engagement with researchers, Marck et al. (2006b) argue that practitioners can enhance their self-monitoring capacity and adjust their practices to support system integrity and health of people within complex systems.

A third element of the restorative approach in health care research, adaptive learning and growth, is incorporated throughout the conduct of restoration research, rather than viewed as an outcome of completed research. From ecosystems management literature, adaptive management is thought of as a systematic process wherein researchers, decision makers, practitioners and community members integrate the knowledge they gain from credible science, system changes and adaptations, and their own experience and values to make effective and collaborative decisions within a system (Adaptive Management Practitioners Network, 2007; Gunderson et al., 1995). Restoration thinking in health care is intended to promote adaptive management whereby community members at individual, team, organization, and system levels develop and translate their learning into restorative cycles of study, action and evaluation to inform their practice as they generate sustainable improvements for their shared place (Marck et al., 2006a; 2006b, 2006c). Adaptive learning and growth are viewed as realized when practice communities, health care organizations and systems draw nearer to "concrete, consistently safer outcomes for both the

providers and the recipients of care…which is really to reach a condition in health care and in ourselves that is adequately restored" (Marck et al., 2006b, p. 24).

A fourth element of the restorative approach in health care research is citizen science. Marck et al. (2006b) defined citizen science as a process of generating knowledge and new understandings about a phenomenon as researchers work with community members and decision makers as participants "to collaboratively study and adaptively manage nested cycles of systems growth, decline, and renewal" (p. 44) in the context of the participants' home place. Similarly, Irwin (1995) described citizen science as a collaborative process whereby researchers work with a community of volunteers (e.g. practitioners) and decision makers to explore and analyze data about a phenomenon of interest, with a goal of generating knowledge that could be used to improve aspects of a shared place or system. Citizen science "refers to the nature of the science [that it is argued] is needed to better understand and manage today's complex health systems" (Marck et al., 2006b, p. 16). Specifically, it is argued that understanding health systems as CAS or SES requires an integrative approach to science that enables people to comprehend and work within the complexities of whole systems in health care (Backman et al., 2008; Edwards et al., 2007; Marck et al., 2006a).

Citizen science has been adopted and applied as a methodological approach in a variety of disciplines. Examples include studies in ecosystems management to survey natural resources (Cohn, 2008; Galloway, Tudor, & Vander Haegen, 2006), in education to explore attitudes towards science as a phenomenon (Brossard, Lewenstein, & Bonney, 2005), in political science to ascertain the risk

to a community from radioactive waste (Chilvers, 2007), in medical and health policy (Couvet, Jiguet, Julliard, Leverel, & Teyssedre, 2008; McCormick, Brown, & Zavestoski, 2003), and in nursing (Marck et al., 2006a). In keeping with the principles and practices of good restoration (Higgs, 1997, 2003), citizen science is participatory in nature, contextual, and characterized by iterative cycles of observation, monitoring, and analysis by researchers and participants within a shared place. Citizen science is therefore a key methodological aspect of restorative research in health care, underpinned by assumptions that researchers and community members collaborate to access multiple perspectives which incorporate both citizens' indigenous knowledge, such as local historical, cultural, and practice knowledge (Marck, 2006; Marck et al., 2006a; 2006b; 2006c) and pure critical views (Couvet et al., 2008; McCormick et al., 2003). The goal of this inclusive methodological approach is to collaboratively choose research problems, generate new knowledge and foster adaptive learning and growth about the places we share (Higgs, 2003; Irwin, 1995; Marck, 2006; Marck et al., 2006a; 2006b). This new knowledge may be re-examined, tested, and translated by participants throughout the research as they engage to restore safety in their systems.

Citizen science allows for a choice of methods to promote understandings about the phenomenon in question and to influence actions. The choice of methods within citizen science is based on four key assumptions which reflect the philosophical underpinnings of the restorative approach (Marck, 2006; Marck et al., 2006a; 2006b; 2006c). Firstly, interested individuals in a community are engaged as active *participants* in research to collaborate and benefit from

knowledge sharing and knowledge generation about their shared place, system, and practices. Secondly, knowledge is wrapped *contextually* within a shared place (Higgs, 1997; 2003; Marck, 2006; Marck et al., 2006a; 2006b) as participants have indigenous knowledge specific to their shared place. Thirdly, a *variety of research methods* may be chosen to answer study questions. Citizen science methodology is used to generate community members' perspectives about a phenomenon with methods such as process mapping (Turnbull, 2007), "storying, re-storying and restoring places" (Marck et al., 2006c, p. 3) with photo elicitation and photo narratives (Marck et al., 2006a; 2006b; 2006c; Higgs, 2003), and field observations to develop an understanding of socio-ecological dynamics (Holden, 2005). Fourthly, data are collected and analyzed as an *iterative* process that begins as the researcher asks participants to share their perspectives of processes in their system and progresses through revisiting, re-visioning, and reflecting on interactions with each other and their environment to posing critical questions and dialogue to generate new knowledge. This new knowledge may be a basis for participants to discuss and test ideas for restoring or improving conditions and to reach shared understandings of the reciprocal connections between the place they share and the phenomenon (Higgs, 2003; Irwin, 1995; Marck, 2006; Marck et al, 2006a, 2006b, 2006c).

The philosophical assumptions of a restorative approach in health care research, including the use of citizen science, are consistent with a critical realist view of research. For example, Clark (2008) asserts that a research perspective from a critical realist stance includes an understanding that "Critical realism

simultaneously recognizes the existence of knowledge independent of humans but also the socially embedded and fallible nature of scientific inquiry" (p. 167). Tenets of critical realism informing this study included:

1. real world phenomena exist independent of human consciousness (Clark, Lissel, & Davis, 2008) and can be studied to apprehend and provide "deeper levels of explanation and understanding" (McEvoy & Richards, 2006, p. 69);
2. real world phenomena exist in systems influenced by "numerous factors (that) are present and interact in highly complex and variable ways over time and context" (Clark et al., p. E-71) ; and
3. the context shaping the nature of real world phenomena include "underlying structures, powers (agency) and processes" (Clark et al., p. E-69).

Thus, with a critical realist perspective, medication safety requires exploration where it exists within a health care system, rather than in a laboratory, to develop understanding of this complex phenomenon and the elements that influence medication safety in context. These assumptions from complexity thinking, restoration thinking, and critical realism guided me as a researcher through each cycle of data sampling, collection, and iterative analysis, as findings were shared with participants for critical discussion. Data collection and analysis proceeded concurrently as I continuously checked and revisited data. In the next sections, I outline research methods I used to answer my research questions.

Sampling Strategy

Sampling. Purposive case selection (Clark, 2008) was used to select a hospital unit where practice community members with breadth and depth of experience providing patient care and prescribed medications for patients were willing to participate and capable of articulating their viewpoints about and experience with medication safety. To explore medication safety and answer my research questions, it was important to engage with practitioner community members on a hospital unit who met these inclusion criteria.

Practitioner participants (n=68) were recruited to collaboratively explore, reflect upon, and generate new knowledge (Creswell, 2003; Miles & Huberman, 1994; Spradley, 1980) about medication safety in focus groups and photo walkabouts. Clark recommends purposive sampling to study phenomena using qualitative method and critical realist assumptions. Purposive sampling coheres with principles of the restorative approach in health care (Marck, 2006; Marck et al., 2006a; 2006b) to study and generate knowledge about a phenomenon by engaging with health care practitioners and decision makers as participants in their shared place.

Context. The study unit was a 37 bed surgical unit in a mid-sized Canadian hospital. The hospital medication system and processes were used throughout the institution, and related everyday events and processes were observable on the study unit. Unique unit characteristics included the unit's history, culture, and social relationships that could influence how processes were carried out within the hospital medication system.

One aspect of registered nurses' (RNs) and licensed practical nurses' (LPNs) work with patients on this unit was medication preparation and administration. On the study unit, five teams of nurses worked twelve-hour shifts, seven days a week to provide nursing care to patients. There were 72 RNs and LPNs on the unit roster at the time of this study, plus a dedicated full time nurse manager, clinical nurse specialist, and two nurse educators. Several senior nurses had 15 to 25 years of nursing experience, and most nurses had one to 10 years of experience; 56 out of 72 nurses (77.8%) on this unit participated in one or more phases of the study. Nursing unit clerks and service aides also worked on the unit.

Several medication-related procedures other than medication administration were visible in this hospital unit and context, including:

1. physicians ordered each patient's medications on that patient's chart,
2. nurses on the unit, and a pharmacist who could be off-unit, checked medication orders; RNs or unit clerks transcribed orders
3. a pharmacist entered each patient's medication orders into a computerized pharmacy order entry system, and
4. medications were distributed to nursing units from a central pharmacy, and placed on medication carts or locked in the medication room.

The physical structures (e.g. patient rooms, storage areas) and medication systems (e.g. cart based unit dose medication system, documentation system, information systems) are also important context for this study. For instance, medications were stored in various locations on the unit, with narcotics, controlled, and stock medications stored in a central medication room and on

medication carts in unit hallways. Hospital-wide medication policies, some of which stem from federal regulations, outlined specific procedures to provide and administer medications to patients. For instance, nurses documented by hand writing on each patient's chart as they administered medications, and narcotics and controlled drugs were accounted for by signing on pharmacy-generated narcotic control records. Pharmacy technicians maintained records of controlled drugs purchased and dispensed in this hospital to comply with federal regulations.

Participants. Nurse participants eligible to participate in study focus groups and photo walkabouts included RNs and LPNs employed on this unit who had completed nursing orientation and who administered medications as part of their regular practice on this unit. A mix of more and less experienced nurse participants with between one to 25 years of nursing experience contributed a variety of perspectives about supports for and threats to medication safety on this unit. The nurse manager, clinical nurse specialist, nurse educators, pharmacists, and pharmacy technicians were also eligible participants, as they contributed to the provision of medications for patients on this unit, and some had decision-making capacity.

Physicians, unit clerks, and service aids were not recruited to participate as they did not routinely administer or provide medications to this unit. However, any voluntary discussion about medication safety that physicians, unit clerks, and service aides on this hospital unit initiated with me during my observation times, as I identified that I was a researcher studying medication safety, was welcomed.

Pharmacists and pharmacy technicians who provided medications for patients on this unit, by entering orders and distributing medications, were also eligible to participate, as they could provide insights into aspects of medication safety relevant to their roles. In total, two out of the four pharmacists who worked on this unit (one with more than 20 years of experience, and one at the beginning her career), one pharmacist who is a pharmacy manager, and 9 pharmacy technicians out of 13 (69%) who covered this unit (two senior technicians with more than 20 years experience and seven with two to ten years experience) participated in focus groups or a photo walkabout (n=12).

Recruitment. With permission from the nurse manager and pharmacy manager, I placed posters advertising this study on the study unit and in the pharmacy department to recruit participants in February, 2009. Potential participants were invited to contact me through my contact information on posters, or leave me a note in a sealed drop box. I visited these units to answer questions about my study at times noted on recruitment posters, and contacted those who left messages for me. This recruitment strategy worked well to access potential participants interested in medication safety and willing to share a variety of perspectives to develop understanding about complex influences that shape medication safety in this context. A sampling frame (see Table A) shows linkages between my research questions, what was sampled, and my sampling rationale.

Table A: Sampling Frame

Research Sub Question	Sampling what, how and with whom	Rationale for this sample
"How do participating nurses (RNs and LPNs, pharmacy workers, and decision makers) describe their current system and processes associated with medication administration safety?"	Participants' perspectives of medication processes associated with medication safety in the current system, through purposive sampling about the phenomenon, with practitioners who provide medications to patients in this hospital, specifically 56 RNs and LPNs, 9 pharmacy technicians, and 3 pharmacists. Four focus groups were held; each group had 4 to 12 participants.	Data gathered with practitioners who have direct experience with medication processes and systems on this unit. Morgan (1993; 1997), recommends 3-5 focus groups with 6-10 participants per group when the discussion purpose is to explore experiences with a phenomenon. Clark (2008, p. 168) asserts that from a critical realist perspective, "sample size is determined by the number of respondents to fully uncover the essence of the object of inquiry".
"What elements in their present environment do participants identify as contributing to medication safety on their unit?" and "What elements in their present environment do participants associate with near misses, medication errors, preventable adverse drug events, or other medication-related harms?"	Images of areas on the unit which from participants' perspectives contributed to medication safety or risk were sampled with photo walkabouts. Participants collaborated to frame and collect photographs and discussed why each area was significant. I audio recorded what participants discussed as I photographed areas. Participants included the nurse manager, nurse educator, clinical nurse specialist, pharmacist, pharmacy technician, RNs, and LPNs.	Data were gathered about this phenomenon with people who have direct experience with medication safety in their work environment. In each of 4 photo narration sessions, an average of 3 practitioners or decision makers participated. The rationale for sample size is drawn from previous work on hospital unit photo walkabouts with practitioners by Marck et al. (2006a; 2006b).

	Sampling Frame continued	
Research Sub Question	**Sample what, how, and with whom**	**Rationale for this sample**
"What potential supports for and risks to medication safety are observable on the participating acute care hospital unit?"	Observations on the unit recorded as field notes about unit activity, linkages, dynamics, and pace of work, team relationships and staff interactions, signs of unit culture, the environment and socio-ecological aspects of the workplace as these influence medication safety. Observations ranged from 2 to 6 hours at different times and days, over seven months. Observations continued as people on the unit became comfortable with my presence and I saw beyond surface actions and interactions.	Data were gathered about medication safety as it existed in day to day activity, systems and processes, interactions and relationships on this unit that were observable using all my senses. The rationale for using observations to sample this phenomenon was that supports for and potential medication risks were embedded in systems and processes, and conveyed by verbal and non verbal interactions and actions.
"From the knowledge generated in this study, what changes to their medication administration systems, processes, unit practices, policies, and/or unit environment do participants identify as feasible and desirable to enhance medication safety?"	Participants' perspectives about photographs of areas on the unit (photo elicitation), and themes interpreted from the data to this point were shared and discussed. These perspectives were sampled in four focus groups: two with RN's and LPN's, one with pharmacy workers, and one with decision maker participants.	To gather data using photo elicitation about medication safety from participants' perspectives'; such as their views of photographs taken earlier that contributes to medication safety on the unit. Groups discussed what they saw that was significant in photos, and what changes participants would make to enhance medication safety in their systems and processes. The rationale for numbers of focus groups was drawn from (Clark, 2008), Morgan (1993; 1997), and Marck et al. (2006b).

Data Management

Data in this study included audio recorded focus group discussions and photo narratives, medication process maps, visual images as photographs, field observation notes, and my researcher journal notes. To manage these data, I reviewed and copied audio recordings from focus groups and photo narratives, I downloaded and copied photographs, and I copied field observation notes and my journal entries. Original recordings, photographs and notes were stored securely as original data. I listened to audio recordings, and these were transcribed and verified. Transcripts in rich text format and photographs were entered, sorted and stored in a data management software program (Atlas.ti, student version), and in data files on a password protected computer in my locked office. Qualitative data management software assisted with data storage and retrieval of text and photographs from files where I stored these, but as researcher, I analyzed data.

Data Collection and Analysis as an Iterative Process

Data collection and analysis proceeded in an iterative process, consistent with the theoretical stance of the restorative approach in health care research (Marck et al., 2006a; 2006b; 2006c). I engaged in concurrent and successive cycles of data examination and interpretation of data from a variety of research methods to answer research questions, and then actively worked with participant practitioners to share preliminary findings in context, as an iterative process. Each cycle in turn generated further data that I analyzed and shared with participants. Table B shows data collection strategies and data analysis techniques for this study.

Table B: Data Collection and Analysis

Data From	Data Collection Strategy	Unit of Analysis	Data Analysis Techniques
First Focus groups	Recorded focus group discussions with participants about medication processes	Participants' discussions	Transcripts: coding, categorizing, and identification of emergent themes as an iterative process
Photo Walkabouts with co-created photographs and stories shared about areas on unit.	Participant-led photo narration walkabouts (lasting about 1 hour each) where participants directed me to take photographs while telling their stories of each area photographed.	Visual images and participant's stories	Photographs, (downloaded) and transcripts of audio recordings were coded, categorized and themes identified, these were analyzed and interpreted separately and together. Analysis continued as an iterative process.
Field observations on the unit	Field notes recorded from 55 hours of field observations.	Field notes of unit observations of systems and interactions, and documents on unit as these related to medication safety	Transcripts: coding, categorizing and interpreting of data, identification of emergent themes as an iterative process.
Second set of focus groups	1. Photo elicitation, participants viewed photographs taken earlier of areas on unit and responded with sometimes divergent viewpoints. 2. Audio recorded discussions where participants built on new knowledge to envision medication safety improvements in their area.	1.Communal discussion of medication safety and medication risk areas 2. Participants' discussions about photos, themes and ideas about medication safety.	Analysis of transcripts: coding, and grouping codes to categories, then seeking themes in textual data associated with visual images and in context of the text from ensuing discussions, as an iterative process.

First focus groups. Initial data were collected in focus groups lasting about one hour with RNs and LPNs in a private conference room on the study unit. Eligible volunteers who consented to participate after reading the information sheets provided were included in audio recorded focus group discussions. Participants shared their perspectives about medication safety as they directed me to map their medication processes; participants reviewed and corrected information recorded on their process map as necessary during that focus group. After each focus group, I remained on the unit to be available to anyone who wished to speak with me, and I wrote notes about focus group interactions as field note data. I recorded questions and reflections arising from data in my researcher's journal, discussed these with my supervisor, and used questions to inform subsequent data collection as iterative analysis progressed. Some substantive codes became apparent in these data, and similar and divergent participants' perspectives were noted. A focus group with decision makers and clinical educators on this unit (nurse manager, nurse educators, charge nurse, and a pharmacist) took place next, and the final focus group in this set was with pharmacy technician participants.

Focus groups were chosen as an appropriate data collection method in this exploratory research to bring interested and able practice community members together as participants to collect data to answer study questions. Participants discussed medication safety in their systems and processes, exchanged knowledge, and talked about their thoughts and ideas regarding medication safety with others who had similar or different views (Duggleby, 2005; Fern, 2001;

Morgan, 1997; Redman & Curtis, 2009). Several characteristics of focus groups as data collection method were considered, before I chose this method. Firstly, focus groups as methods must be carefully planned and moderated to elicit comments from all group members and "group interaction in response to researcher's questions" (Morgan, 1993, p. 15). As moderator, I began each focus group in a private room by presenting the research purpose and topic for group discussion to potential participant practitioners (Redman & Curtis, 2009). Before volunteers consented to participate, as moderator, I advised these individuals of risks and benefits to their participation (Hofmeyer & Scott, 2007), including that due to the nature of focus groups, confidentiality of information shared in the group discussions could not be completely assured (Smith, 1995). Risks were described that included participants could disclose information others shared in the group outside the group, and that group members may be silent if they felt constrained by power differentials within the group (Hofmeyer & Scott). Since my purpose for using focus groups was to gather practice community members for facilitated discussions about medication safety, I advised potential participants of risks and benefits before I started each focus group, and I asked each same set group the same general question about their view of medication safety. I was alert for group dynamics, verbal and non verbal signals amongst participants who had pre-existing relationships with others group members that could indicate participants might be withholding their views during discussions (Hofmeyer & Scott). I encouraged participants to share their views about medication safety within the group, and was available to group members after discussions if

participants wanted to debrief or share their evolving thoughts with me outside the group (Hofmeyer & Scott). I valued data collected from group discussions and interactions as knowledge was shared and developed in each focus group (Duggleby, 2005; Hofmeyer & Scott; Kidd & Parshall, 2000).

As the rigor of data collection in focus groups is associated with the researcher following similar procedures during all sessions as outlined by Morgan (1993; 1997), I began each focus group in the first set by asking participants to share their thoughts about current systems and processes they associated with medication safety, and to tell me about their processes to administer or deliver medications to patients. I audio recorded focus group discussions and used sheets of paper affixed to walls and flip charts to draw process maps as participants watched, verified and corrected as necessary my map of their process as they dictated. I saved these maps as field note data. Attention to participants' reflections and critiques of process maps helped to verify how data fit with their current view of medication systems and processes. I followed these strategies consistently to strengthen rigor of focus group data collection (Loiselle et al., 2007; Morse, Barrett, Mayan, Olson, & Spiers, 2002).

The data from focus groups were analyzed iteratively following collection, copying, transcription, and entry into the data management software; I assigned file names (e.g. focus group one) to each data source. Textual data were coded as they were read and reviewed. Process maps were examined and compared to text from the discussion associated with that group, to process maps recorded with other groups, and to other field notes and data.

Similarities between data were annotated and grouped together into codes. When a pattern became visible in data which could be a code (such as participants spoke of checking), I grouped these data and wrote memos about each code. Literature was searched for keywords corresponding to codes arising from the data, and in some instances, a theoretical code (e.g. vigilance) was considered and annotated with data. As textual data, notes, and maps were read, viewed, compared and contrasted, categories started to form. Codes were grouped and regrouped into categories, as I watched for commonalities and relationships between codes and categories in these data. These commonalities and relationships were tested as potential themes in these data; data strands that could be themes were fluid and changed as data were reviewed and moved to see if they fit with more than one code or category, or if there were relationships to more than one theme. In this way, I was alert for themes to emerge from data in a "bottom up" process (Loiselle et al., 2007, p. 395) as relationships were seen. I searched literature concurrently to assess if aspects of data were linked to theoretical terms in scholarly literature, to practice, and to national safety guidelines. I used thematic analysis (Miles & Huberman, 1994) to identify themes as the iterative data analysis proceeded about the phenomenon of medication safety.

Photo walkabouts. As codes became visible in data from initial focus groups, I initiated audio recorded, practitioner-led photo narration walkabouts where participants guided me to photograph areas as they narrated what they saw as important to medication safety. Data collected were images and participants'

discussions about areas important to medication safety. Four practitioner-led photo narration walkabouts were conducted in total: three on the unit and one in pharmacy with 12 participants in all. To strengthen the rigor of data collection, I used an adapted photographic protocol drawn from previous research (Marck et al., 2008; 2006c) and used similar prompts to begin each photo walkabout with participants to encourage them to discuss and story the meanings and significance of objects or areas they wanted photographic images of (Loiselle et al., 2007; Marck et al, 2006a).

Photo narration is used with diverse methodological perspectives in health, social sciences, and restoration science to explore phenomena. Health researchers used photo narration to explore people's stories of health related concerns (LeClerc, Wells, Craig, & Wilson, 2002; Moffitt & Vollman, 2004), seniors' perceptions of community environmental barriers to walking (Lockett, Willis, & Edwards, 2005), and nurses' perceptions of work in a hospital operating theatre (Riley & Manias, 2003). Social scientists used photo narration as research method, and one researcher described that this method demonstrated an "epistemological commitment to the ways participants themselves interpret, give meaning to and make sense of their experiences" (Harrison, 2002, p.864). Rieger (1996), a social scientist, used photo narration to study relationships between visible changes to places and social change, and Frith and Harcourt (2007) used photo narration to explore women's experiences of chemotherapy to treat breast cancer. In restoration research, Higgs (2003) used photographs to depict changes in a national park's vegetation and landscapes, comparing current and historical

photos of park landscape in order to track human activity and engage community members in creating and exploring narratives of the park space they inhabited over time. Adapting from Higgs' work, Marck and colleagues developed and used restorative methods of photo narration to obtain practitioners' stories of medication safety (Marck et al., 2008; 2006a).

In my research, there were several advantages of using photo walkabouts to engage practitioners in constructing visual narratives about medication safety in their practice environment. First, practitioner participants led us to areas they thought of as significant to medication safety on their unit and wished to have photographed, and discussed reasons why each area was meaningful. In this way, participants focused attention on and data were collected about areas that participants viewed as influential to medication safety on their unit. Second, by leading the researcher and narrating photo walkabouts, participants visualized and discussed the way things were on the unit at that time, noted past conditions and areas on the unit, and raised possibilities for strengthening medication safety. Third, leading and narrating photo walkabouts about medication safety engaged participants to self-monitor and consider what they could or might do to correct problem areas they pointed out and question medication safety as a phenomenon within their complex care environment. Fourth, collaborative knowledge development and exchange occurred during each photo walkabout as participants shared their views of the meaning and significance of areas with the group. Similar advantages were observed and reported by Marck and colleagues in their restorative research in health care (Marck et al., 2008; 2006a; 2006b; 2006c).

Pink (2001) asserts "individuals draw from personal and cultural resources of visual experience and knowledge" (p. 27) to identify areas they want to capture as images in photographs. I used the following procedure to collaboratively frame photos during the photo narration sessions as participants identified and discussed "those problems that matter most to them" (Marck et al., 2008, p. 2). Digital photographs of areas of interest to participants were co-created as participants led me to and located the area they wished to have photographed, as I framed an image of the selected area in the camera's viewfinder and participants viewed that image with me. Image reframing, adjustments, and corrections were repeated until participants indicated they were satisfied with an image seen in the viewfinder, that they described as clearly capturing what they wanted framed in the photograph, and then a photograph taken. After a photo was taken, participants were shown that image of the area on the digital camera photo review screen, and if the image was not quite right, the angle or position of the camera was adjusted, the image was rechecked with the participant until the desired image was captured, and then the area was re- photographed, and the image was shown again to the participant for confirmation. In this way, photographs were co-created by participants and researcher, in accord with citizen science (Marck et al., 2008). Participants' narration of the significance of each area photographed to medication safety was audio recorded; during these narrations, participants often revealed indigenous knowledge of their unit's history and systems.

Data from photographs, uploaded and images checked for clarity and content, and stories copied, checked, and transcribed from photo narration

walkabouts with participants were labeled, viewed and analyzed separately, and then in concert with other data. With "visual research, this means scrutinizing the relationship between meanings given to photographs [by participants]" (Pink, 2001, p. 95), which could be revealed in their stories, and the meaning and relationships of areas photographed to participants' perspectives of the phenomenon which are "anchored in an image that is understood, at least in part, by both parties" (Harper, 2002, p. 20).

Photographs and textual data were analyzed by coding, categorizing, and seeking themes in visual images of areas and objects on the unit, and with data from focus groups. New codes became apparent in photographs of areas on the unit that support safety and areas of concern for participants related to the intra or extra organizational context of the unit. Previous categories and themes were reconsidered as these new data were analyzed. Practitioners' narratives enriched how the researcher viewed photographs of areas, and revealed how they adapted their practice based on their indigenous knowledge of the unit, their patients, and medications. Iterative data analysis continued as all data were viewed, read and reviewed and the researcher moved back and forth linking with and referring to earlier data.

Observation. Fifty five hours of field observation over a seven month time period yielded rich data about the phenomenon which were recorded as field observation notes. Spradley (1980) purports that methodical data collection from observations provides a researcher with an opportunity to be in a field context with people and to view firsthand how these people adapt their actions to what is

happening in their environment. Observation as method was used to collect data in several studies, for instance researchers observed with participants to assess the nature and extent of risk from radioactive waste in their community using citizen science in one study (Chilvers, 2007). In health care research, Baker (1997) used methodically observed nurses' practice associated with medication administration; Carroll, Iedema, and Kerridge (2008) used observations to record communication patterns between clinicians in intensive care units; and Forbes-Thompson et al. (2007) used observations to gather data about systems, processes, interactions, and complex relations occurring in nursing homes. Observation was a method used in several studies to detect medication administration errors following a research intervention (see Greengold et al., 2003; Helmons et al., 2009; Pape, 2003; Schneider et al., 2006). In my study, field observation as method placed me as the researcher "in the field with local citizens and stakeholders…to see the value of history, culture and the way the community practices" (Marck et al., 2006b, p.12).

My initial observations were mostly descriptive as Spradley (1980) suggests is often the case as observation begins. I recorded people's visible activities on this unit, as they interacted as an integral part of, rather than separate from, both their immediate human-made environments and the larger socio-ecological system in this hospital (Marck et al., 2008; Marck, 2006; Marck et al., 2006a, 2006b). I observed people going about their work, and in particular, any visible or audible interactions involving medications, including how individuals and members of this practice community responded to people and events. An example

of a recent change that participants pointed out to me and described was their medication reconciliation process, which was implemented prior to my study and nurses were required to adapt their practice and learn new ways to ensure patients continued to receive pre-hospital or pre-transfer medications as necessary. Practitioners described how lists of patients' medications were accessed and reviewed with patients to facilitate medication safety for patients on admission, transfer, or discharge from the unit. According to practitioners, medication reconciliation provided opportunities to increase proficiency with obtaining patient information from computers on the unit, and nurses and pharmacists described that re-designed work patterns, adjustments to work processes and relationships evolved.

Observable exemplars of communication networks and ties between individuals and groups were examples of socio-ecological dynamics recorded in notes that pointed out "social capital at work" (Hofmeyer & Marck, 2008, p. 146) on the unit, as individuals communicated with others. Relationships among practice community members and co-workers were observed, such as who works with whom, and how; whether groups of people appeared to function as interdisciplinary teams or simply work in shared space; how people spoke to one another, who spoke to whom about what, and who leads which activities on the unit. These were significant relationships to observe because positive team relationships indicate an environment where individuals feel they can discuss insights with co-workers about supports and risks to safety (Carter & Henderson, 2000). Positive relationships demonstrate the socio-ecological concept of culture

and social capital and "linkages between [workplace conditions] and a range of ethical issues" (Hofmeyer & Marck, p. 146), such as how resources were allocated and how practitioners related with one another. Observable indicators of unit culture included people's actions, interactions, and patterns of behavior that conveyed their beliefs, values, and traditions. Field notes from observations were compared and analyzed with previously collected data to identify codes, categories and themes emerging in these data.

Other observations on this unit included the physical layout, spatial dimensions, equipment, noise-level, smells, clutter, and other "sensate experiences" (Edvardsson & Street, 2007, p. 24), which included, for example, the ambiance on the unit. The pace of work was visible and helped me to gain an understanding about the rate, rhythm and pattern of usual work activities and to recognize variations in the volume of work, work processes, procedures or circumstances at different times. Staff interactions with patients were observed from various vantage points mostly from a hallway, at different times to see activities, processes and linkages in this complex system. For many on-unit observations I positioned myself, after receiving permission to observe in that place and time of day from practitioners, approximately twelve feet from where nurses were visible preparing medications at a medication cart, and administering medications to patients in their rooms. At other times, I observed from different spots adjacent to the main nursing desk and medication room to gather data about how and what was communicated, how the unit received medication supplies, and how medication activities were accomplished in this unit environment.

Other socio-ecological aspects of the workplace I observed included indicators of the influence of regional and national regulations (such as how critical incidents were reported, and by whom), of corporate or hospital influences such as labeling on medication containers provided for practitioners to administer, and of other societal developments, such as the current call in developed societies for transparent disclosure of adverse events (Canadian Patient Safety Institute [CPSI], 2008; Vincent & Coulter, 2002; WHO, 2009, Topic 8). Written policies, procedures, and guidelines can influence actions critical to medication safety on this unit; these health region, nursing, and pharmacy documents were accessed and reviewed to provide a context for some of the on-unit activities that were observed.

Two advantages of field observations in this study included the opportunity for me, as researcher, to see how processes and activities discussed or areas photographed in earlier data collection related to the overall function or activity on the unit, and second, for people who wanted to offer their views of medication safety to share these views with me during the study. I compared my observation notes to earlier data from participants' self reports, as I sought "to discover the cultural patterns people are using to organize their behavior, to make and use objects, to arrange space, and to make sense out of their experience…by collecting descriptions of behavior, events, objects, and feelings" (Spradley, 1980, p. 130). A potential limitation to field observation as a data collection method was the possibility that my presence affected activities on the unit in unknown ways, as people could have behaved in atypical ways when they knew they were

being observed (Loiselle et al., 2007). A second limitation was that only certain activities could be observed, as some processes were not observable, which does not mean they did not exist. These limitations were seriously considered and weighed, and I used strategies to reduce potential discomfort for people that could accompany my observations. For instance, I asked permission to observe in the area from the nurse manager, charge nurse, and any nurse that was in my view with every observation. I remained in an area to observe only when I was given verbal assent to observe as a researcher, and was pleased to learn that practitioners and decision makers welcomed me to observe on every occasion I requested. I was even asked on three occasions "where I had been" when time had passed since I was last observing on the unit.

Field observations for data collection lasted from two to six hours at any one period of time, and continued until I was not recording new data from observations. Field notes were methodically recorded, checked, photocopied, transcribed, and entered into Atlas.ti, then reread and coded (Spradley, 1980). Critical reflection about and dialectical analysis of the data occurred in an iterative process as data were gathered and compared with previous data, and with findings in previous studies or theoretical literature (theoretical coding). Rigor in data analysis was enhanced by careful evaluation of all field note entries about the multiple aspects I observed; I recognized that no single observation or source of information provided a comprehensive perspective of medication safety (Patton, 2002). I was alert when I analyzed these data for "notable non-occurrences" or when "the absence of some particular activity is noteworthy" (Patton, p. 296)

related to medication safety. Themes were compared and contrasted to themes throughout data analysis and often appeared as "nested within overlapping or intersecting units of analysis" (Patton, p. 298). Codes, categories and themes interpreted from observation field notes as data were questioned and discussed with my supervisor as a further level of critical analysis. Consistent with the restorative approach (Marck et al, 2006a; 206b; 2006c), themes were shared with participants for critical appraisal and discussion in a second set of focus groups.

Second focus groups. Photo elicitation was conducted with participants in a second set of four focus groups. Participants were invited to view photographs taken during photo walkabouts and share their stories of medication safety in relation to what they saw in photographs. During the photo elicitation focus groups, participants discussed and shared their perspectives of supports and barriers to medication safety, critiqued themes that I had interpreted from data collected to date about medication safety, and suggested ways that medication safety on their unit could be improved. The rigor of data collection in this set of focus groups was strengthened by using the same procedures and initial questions in each focus group as participants viewed and discussed photographs and responded to my preliminary themes. Focus group prompts were based on analysis of data collected earlier in my study.

Photo elicitation has been used by researchers in several studies to elicit participants' responses to visual data (Harper, 2002) and gain information that might not emerge without the stimulus of visual images (Beilin, 2005; Clark-Ibanez, 2004). Hansen-Ketchum and Myrick (2008) assert that photographic

methods can be used in qualitative research from a variety of ontological and epistemological perspectives. In restorative research, in addition to documenting local conditions from insiders' perspectives in photographic walkabouts and using images to elicit insider views of relevant phenomena, both Higgs and Marck engage participants in photographic fieldwork to encourage community members to actively recall, respect and story the past, collectively question and re-story the present in light of the past, and thereby establish a narrative continuity to help them to re-imagine different potential futures for shared places (Marck et al., 2008; Marck et al., 2006a; Marck et al., 2006b; Higgs, 2003). Building such narrative continuity in a place enables researchers and communities to "bring the best of the past forward" (Marck et al., 2006b, p.3) into future-oriented restorations which community members can find useful, feasible, and sustainable over time (Marck et al., 2008; Marck et al., 2006a; Higgs, 2003).

Critical analysis of these transcribed focus group data continued as I interpreted how practitioners as community member participants viewed and discussed meanings of areas and objects photographed, what participants associated with medication safety in photographs, and how participants discussed what they could improve for medication safety on their unit. These data from focus group discussions were viewed in relation to earlier data; new and revised codes and categories were identified as data were analyzed and re-analyzed. Following initial coding, categorizing and interpreting themes from these data, critical discussions about these data were held with my supervisor. In these conversations, we questioned whether themes I had derived from the data

accurately reflected what was in these data, if my research questions were addressed, and if a more fulsome understanding of medication safety on this unit was apparent.

Rigor

In the first segment of this section, I address overall rigor with the qualitative methods used in my study and outline research activities congruent with verification strategies (Morse et al., 2002) that I used. Next, I consider how a researcher in the research can influence overall study rigor, and what strategies I took to uncover and monitor my own biases throughout the research. In the last segment in this section, I describe how I engaged in reflexivity and maintained an audit trail during the study to support rigor of this research.

Overall study rigor. Rigor must be established, maintained, and "built into the qualitative research process" (Morse et al., 2002, p. 9) to ensure credible findings. The verification strategies outlined by Morse et al for establishing reliability and validity in qualitative research were employed throughout this study. These include "ensuring methodological coherence, sampling sufficiency, developing a dynamic relationship between sampling, data collection, and analysis, thinking theoretically, and theory development" (p. 11). I review these strategies with examples from my research here.

1. The research questions guided my selection of methods as I sought to explore medication safety with participant members of this practice community using the restorative approach in health care research (Marck et al., 2006a; 2006b). My methods matched my questions, and

data were collected with participants in response to these questions and methods and analyzed in an iterative fashion. This analytic strategy generated additional questions which were taken to participants in further phases of data collection. My study demonstrated the fit between sampling procedures, data collection and data analysis to ensure "methodological coherence" (Morse et al., 2002, p.12) with the theoretical framework of the restorative approach in health care (Marck et al., 2006a; 2006b; 2006c). The detailed research methods show how this study fit together and how "components of the data meet the analytic goals" (Morse et al., p. 12).

2. The sample unit was purposively selected, based on an expressed mutual interest in exploring the phenomenon. The sample was appropriate, "consisting of participants who best represent or have knowledge of the research topic" (Morse et al., p. 12) and who were willing to engage with the researcher to explore the phenomenon in their shared place. Data categories were saturated and supported by the data which verified findings.
3. Data were "collected and analyzed concurrently" as an "iterative interaction between data and analysis" (Morse et al., p.12). Data quality and saturation were continually assessed, as data from different sources were sampled about the phenomenon of interest. The researcher collected data with participants on this unit over a period of eight months (prolonged engagement) (Spradley, 1980), and changes over

time in data were noted and analyzed. Negative cases were sought and examined from contrasting views to expand the exploration of medication safety. My research journal reflected not only my ideas and decisions as data collection and analysis proceeded, but questions that I pursued in each phase of data collection as the research progressed. These notes, organized and saved electronically, served as my audit trail, and I frequently reflected on these as checkpoints during data interpretation.

4. I engaged with participants and my supervisor and co-supervisor to "think theoretically" (Morse et al., p.13) as a strategy to establish rigor. During data collection and analysis, I examined and questioned each datum, and pondered the meaning of data as a whole in the context of this study and actively responded to each code, category and theme as analysis proceeded. As themes emerged from data, they were brought to participants for review and critical discussion. Themes about supports for and barriers to medication safety as a phenomenon in a hospital unit were developed from the knowledge generated with participants in this study.
5. Theory development according to Morse et al. (2002) calls for a researcher to move "with deliberation between a micro perspective of the data [to] a macro conceptual/theoretical understanding" (p.13). I immersed myself in data during data collection and analysis, occasionally stepping back from the in-depth sentence by sentence

> analysis, in order to see the depth and breadth in these data. In this way, I developed an understanding of medication safety as it operated during my period of data collection with practitioners in their practice, unit structures, culture, and systems, and what practitioners envisioned would restore aspects of medication safety. Theory development was seen when the researcher and participants (perhaps in different ways) developed conceptual understandings of medication safety on this unit. In combination, "all of these verification strategies incrementally and interactively contribute to and build reliability and validity, thus ensuring rigor" (Morse et al., p. 13) in my study.

The strategies I used to "help establish the truth claims of qualitative research" (Rossman & Rallis, 1998, p. 45) included (1) gathering data over a period of time rather than in one sampling episode, (2) sharing interpretations of the emergent findings with participants, (3) designing the study as participatory from beginning to end to ensure that "the truth value of what you discover and report is intimately linked to participants' understandings" (Rossman & Rallis, p. 45), and (4) drawing data from several sources and methods to strengthen the value of conclusions (e.g. participants' perspectives, observations, photographic methods). Clark (2008) asserts that drawing data from several sources and methods in qualitative research from a critical realist perspective helps to strengthen rigor of the study. Consistent with a restorative approach in research (Marck et al., 2008; Marck et al., 2006a) and citizen science methodology (Couvet et al., 2008; Marck et al., 2006a; McCormick et al., 2003), participants as

community members contributed to data collection and data analysis as "a process of sequential reflection and action, carried out with and by local people rather than on them" (Cornwall & Jewkes, 1995, p. 1667).

Researcher in the research. At the time of this study, I was a researcher, a doctoral candidate, registered nurse, nursing instructor (on leave of absence), and a former full time employee (a decade ago) in this hospital. I am interested in medication safety; my biases could have affected the study in some way of which I was unaware, imposing potential limitations to data collection and analysis. To uncover and recognize potential personal biases, my co-supervisor Dr. Allen interviewed me prior to data collection. I recognized that I have a positive bias towards registered nurses administering medication, as I am a registered nurse and I frequently see the best in people. This was not an unforeseen bias, and I consciously worked to increase my awareness and keep open to all activities and discussions while collecting and analyzing data. I recognize that I have a bias in that I value and respect the practice knowledge of health care workers that can shape patients' experience in hospitals, and to address this bias, I consciously worked to not focus solely on any one element contributing to medication safety raised during the study. I believe that in order to achieve a robust understanding of medication safety, members of a practice community must be engaged to explore this phenomenon in the context where it exists in a health care system, to critically discuss their views of medication safety, and to view and discuss findings during data collection and analysis. Knowledge generated about feasible changes for medication safety improvements on this unit were shared with participants as they

arose during my study. I recognized and used my biases to support my study approach, following data collection and analysis methods scrupulously and documenting my reflections and questions in my researcher's journal, including critical conversations about what appeared in the data with research participants and with my supervisor, co-supervisor and committee.

Reflexivity and audit trail. To approach this research ethically, and to "develop a practical and visible process of reflexivity" (Malacrida, 2007, p. 1329), I recognized my interest in medication safety as it exists in hospital units led me to choose this topic and this research methodology. Throughout the study, I recorded research-related thoughts, perceptions, questions, data interpretation flashes, theoretical notes, issues that arose in data collection and analysis processes, methodological insights, and self-reminders to check relevant literature in my researcher's journal (Borg, 2001; Tuckett & Stewart, 2004) to add depth and rigor to the research by exposing influences that shaped my research. I wrote about my thoughts, questioned what I was seeing and interpreting in my data, critiqued the research processes, including decisions I made in my research, and scrutinized my reflections as I explored and questioned my assumptions and how these shaped my research. I documented my interpretations of data and how I was seeing knowledge generated in this study. Thus, my researcher's journal was where I documented reflexivity (see Somekh, 2008, p. 6; Smith-Sullivan, 2008, p. 214) and served as a component of my audit trail regarding how my thoughts progressed, and the influences, plans and achievements, and decisions I made during my study (Borg).

Data in a researcher's journal can be limited if solely focused on subjective impressions; or subject to bias when a researcher focuses on one particular process or element. I was aware that if I fell into this habit, I could miss something else in the study. To overcome these potential limitations, I critically examined my journal entries for evidence of tunnel-vision or undue influence of the researcher on the research (Borg; Janesick, 1999). As Janesick suggests, and I learned, these checks served to correct problems as they arose and aligned data collection and analysis with what was appearing in my data.

Ethical Considerations

Institutional ethics review certifications were granted by ethical review bodies at two universities and the health region where the study took place. Ethical approval was one measure to ensure that this study as designed met standards for ethical research, including respect for persons and their rights to free and informed consent, protection of their information, and freedom from harm. Specific measures to ensure ethical standards were maintained in this research are reviewed next.

Volunteers were recruited by posters put up where potential practitioner participants would see and could contact me if they wished to discuss my study. Posters included the statement "Participation in this study is completely voluntary; you are not required to take part in this research". No one was expected, coerced or required to participate, and potential recruits were informed that decisions about participation had no bearing or association with their employment. Potential harms and benefits from study participation were outlined

for potential participants in information letters which participants read before participating in focus groups and the photo walkabouts (Appendix A). After reading information letters, potential participants were asked if they had any questions about the research, which I answered, and if they were satisfied with their understanding of this research, the procedures and potential harms, benefits and outcomes, they read and signed two consent forms, keeping one signed consent form and returning one to me, as researcher. I collected signed consent forms and stored these in a locked research cupboard in a locked office separate from research data; these will be retained for a period of seven years, and then all data will be destroyed, as described in ethics certifications.

Prior to collecting data in focus groups or photo walkabouts, I drew participants' attention to the information letter and emphasized several points. First, potential participants were not required to participate in the research, and were free to withdraw at any time. Second, participants were free to share information regarding medication safety in focus groups or during photo walkabouts that they were comfortable sharing, but participants were not required to disclose any information at any time. Participants were informed that information they shared could contribute to an understanding of medication safety and to ideas for improvements to medication safety on their unit, and results will be reported. Participants were given my contact information on their signed consent form, as well as that of my co-supervisors as co-investigators in this research, a faculty of nursing research officer from the University of Alberta, and

the contact information for Human Research Ethics Review Board Officers who approved the study.

The information sheet included statements that participants could benefit from their participation in this research by sharing their knowledge or learning from and with other participants through discussions about medication safety. Participants could have benefited through participation in dialogues as they generated and tested ideas for ways to improve medication safety on their own unit. I informed participants that they might be observed and/or overheard by co-workers (entering or leaving a private conference room for a focus group or during the photo walkabouts) and that they would be aware of each other's participation in the research as they took part in focus groups. Research sessions were held during work time, as arranged with the unit manager.

As the research methods involved a variety of participants discussing medication safety or guiding the researcher to photograph areas on their unit, complete confidentiality of information could not be assured between participants, and anonymity between participants was not possible in this study. Other co-workers saw participants taking part in the photo walkabouts, and participants saw and spoke with each other during photo walkabouts and focus group discussions. These limits to privacy protections within the research were not only viewed as acceptable within the constraints of a participatory research approach; the nature of these forms of data collection was seen as a valuable way for research participants to critically dialogue with others about the topic, enhancing collaborative knowledge sharing and exchange. Notwithstanding this open

discussion during the study, participants' names were not associated with any of the research data, and names and identities were protected, and did not appear in transcripts or in notes. All research data were safeguarded. Originals and copies of recordings, transcripts and photographs were locked in a filing cabinet, in a locked office to which only I have a key. Transcripts and photographs were also stored with the software program, password protected on my computer, which is locked in my office. Only the researcher's supervisor had access to portions of raw data besides the researcher. When photographs and themes from the data were shared with participants, no names or individual information was included. All research data will be safeguarded for seven years, and then destroyed.

To maintain the highest possible degree of confidentiality, participants were asked to respect the integrity of any information shared during data sampling by not repeating the information verbatim or in association with specific participants outside of focus groups and photo walkabouts. To emphasize the importance of confidentiality, participants were advised that they were not required to participate or to share any information that they were not comfortable with sharing with the group, or which potentially could be reported as an excerpt in the research report or in discussion of research findings. Participants were informed that their names or identities would not be associated with any quotations used when reporting themes from this research, although their words might be recognizable to others who know them. Since participants on this unit knew each other, the importance of maintaining confidentiality of data was emphasized and I drew participants'

attention to the area of the consent form where they affixed their signature promising to keep information shared in the study in confidence.

As my research purpose was to explore medication safety with practitioner participants on this study unit, I asked participants to identify supports for and barriers to medication safety on their unit, and to discuss their ideas with co-workers for ways they might restore medication safety as they identified barriers. Participants discussed these issues and the ways that they adapted their practice to safely manage medications for patients. Participants assured me that the information they shared about medication safety had also been shared with decision makers in their setting.

Study Limitations

In this study as with other studies, limitations were present. Recognizing potential limitations allowed me to address these where possible and strengthen rigor in the study. The first limitation I recognized was that although my participation rates were robust, not all eligible nurses, pharmacy technicians, and pharmacists who worked on the study unit participated in the research. Non-participants could hold different, unexpressed views of medication safety that were not included in the data I collected. To address this limitation and provide practitioners who did not participate in focus groups or photo walkabouts with an opportunity to express their views for inclusion in this study, I informed any staff who approached me during my participant observations of the unit about the study, and if they asked me to include their views about medication safety in my

data, I would listen to them and record their comments as requested in my field notes.

Another limitation of my study is that patients and physicians were not included as eligible participants in this study. While this initial use of the restorative research approach and photographic methods was therefore confined to nursing and pharmacy professionals, there would be merit to including physicians' and patients' voices and perspectives in similar future research.

Limitations are associated with each research method that was used in my study. Purposive sampling to explore a phenomenon at one location, in one setting, or from only one perspective or method (such as participants' self-reports) posed a study limitation, as possible participants' perspectives are limited to those expressed in these data. This limitation meant findings might not represent the phenomenon to other individuals who have experience with it (Miles & Huberman, 1994). I sampled this phenomenon purposively on a single patient unit because, as researcher, I sought rich in-depth information to develop understanding of medication safety on a hospital unit, with members of a practice community who were willing to explore, reflect upon, and generate new knowledge about medication safety (Creswell, 2003; Miles & Huberman; Patton, 2002; Spradley, 1980). The sampling strategy, characteristics of participants, setting, context, and research processes were fully described so that readers can compare the sample from which these data are drawn with other samples and contexts.

Purposive sampling on one unit fits well with the restorative approach in health care research (Marck, 2006; Marck et al., 2006a; 2006b) and with citizen science methodology (Irwin, 1995), as this phenomenon was explored with a variety of participants where the phenomenon existed (Loiselle et al., 2007). The phenomenon was sampled using various data collection methods with participants from various disciplines (RNs, LPNs, pharmacists, pharmacy technicians). The researcher examined all data very closely for negative cases. On one unit, findings could be and were critically reviewed and discussed with participants to ensure that findings made sense, and participants were asked to consider if findings reflected their understanding of medication safety. This depth would not have been feasible to achieve within my resources as a PhD candidate if data from multiple units were sampled.

Each of the four data collection methods has limitations. Data collection in focus groups could be limited when an inexperienced facilitator conducts the discussion, or if the same procedures are not followed in similar groups with the same purpose. I moderated all focus groups as a consistent moderator, audio recorded the discussion in all groups, and consistently began the focus group discussion with the same initial questions in same-set groups. I asked participants to verify that I had correctly recorded what they described on process maps in the first set of focus groups. In the second set of four focus groups, participants viewed eight selected photographs taken earlier in the research as a power point presentation, and additional photographs on poster boards Participants discussed what they saw in each photograph and how they thought that area was related to

medication safety. I presented emerging themes interpreted from data to date with participants for discussion. In this way, information was gathered in each set of focus groups in a similar manner.

Eligible participants were invited, not coerced or required to attend focus groups. A recognized limitation was that non participants might have contributed different data in focus groups if they had taken part. To address this limitation, I was visible and available on the nursing unit and went to pharmacy during the study for practitioners to share their views with me about this phenomenon. This worked well, as people who did not participate in focus groups and knew I was studying medication safety on their unit, freely shared their views at other times. For example, individuals whom I encountered on the unit during field observations shared their views about medication safety with me as they chose. I always asked if they wished to have their views about or experiences with medication safety shared in my data and asked their permission to report their views as shared; if they agreed, I made field notes, and if they did not wish their views recorded, I did not.

Morgan (1997) asserts focus groups are a suitable method to collect data in an exploratory study, suggesting 3-5 focus groups, each with 6-10 participants. Eight focus groups were held in this study, bringing together 68 interested eligible practitioners and decision makers in groups with 4 to 14 participants; some participants attended focus groups in both the first and second set and photos walkabouts signaling their intense involvement in the study. Data collected from each group discussion was analyzed iteratively and compared to all other data as

the study progressed. Questions and points arising from this analysis were continuously brought to participants for their critical discussion and verification thereby supporting the credibility of study findings (Miles & Huberman, 1994; Morgan, 1997).

Data collection in photo walkabouts have limitations if a photo walkabout is conducted without a guiding protocol, when a researcher is biased, or allows her views to override the participant's desire for particular areas to be photographed. To address these potential limitations, photo walkabout participants were invited to lead the way, functioning as knowledgeable local field guides. Notably, some participants urged me to initiate photo walkabouts soon after their participation in a first focus group. The researcher adapted and used a photo walkabout protocol (Marck et al., 2006c) with 12 participants in four photo walkabouts. This sample size and number of participants per walkabout were congruent with work in Marck et al.'s (2006c) study using photo narration with hospital practitioners. To avoid researcher bias, participants led the researcher to areas they wanted to have photographed, and photographs were co-created as images were selected and approved by participants before a photograph was taken, and then rechecked with that participant to ensure it was the desired image. If a photograph did not capture the desired image, a second, third, and in some instances a fourth photograph of the area or object was framed and taken until participants indicated they were satisfied that what was in the photograph accurately portrayed what participants wished the image to convey. With this method, participants focused on identifying and describing the significance of areas to medication safety, and guided

photograph composition, but were not responsible for the mechanics of operating the camera. Photo walkabouts were arranged in advance with interested participants and resulted in 110 photographs of areas and photo narrations with participants' perspectives, clear images of areas were taken back to participants in the second set of focus groups and used for photo elicitation. Consistency in procedures was thus ensured by the researcher during each photo narration session. Photo narration and photo elicitation contributed to the communal gathering of rich data and led to a deeper understanding of the phenomenon as data from multiple sources was gathered, analyzed and triangulated (Loiselle et al., 2007). No participants dropped out of the study, which indicated participant engagement in the research.

Non-participant observation as a data collection method has limitations if practitioners alter their usual behavior in response to being observed. Recognizing this as a potential limitation, I consistently identified myself as a researcher and explained that I was studying medication safety, not any particular person. I sought permission from practitioners and decision makers to observe in each area of their unit every time I came. I sometimes pre-arranged to come at a particular time, and sometimes I came unannounced. I observed for fifty five hours on the unit, with my first field observation commencing three weeks after the first focus group was held. Regardless of when I observed, participants welcomed me, and discussed medication safety frequently during observation times as different aspects of the phenomenon became visible. Observations recorded over a period of seven months contributed to rigor in data sampling as prolonged engagement in

a setting enhanced the quality and depth of my data (Spradley, 1980). I observed most often from a chair in the unit hallway where patients' or medications' names were not visible to me, and occasionally at the nurses' desk as practitioners reviewed patient's charts and medication orders (e.g. on night shifts). If practitioners administering medications were in my line of sight, I asked permission to observe before recording any notes pertaining to observable behavior and activity.

Each data collection method (focus groups, photo walkabouts, observations, photo elicitation) had limitations, as highlighted above, but in combination, using these methods in one hospital over a period of eight months provided rich data to address the research questions and contribute to a deeper understanding of the phenomenon. Although data were collected prospectively, changes were noted in educational materials posted and medication administration processes over the course of the study, and medication safety was viewed as a dynamic, changing (non static) phenomenon.

Knowledge Sharing and Exchange

In this research, knowledge was developed and exchanged in an ongoing manner as the researcher and participants took part in data collection and critiqued findings of their research collaborations (Marck, 2006; Marck et al, 2006a). Accordingly, research findings were shared with participants in a variety of ways at different stages throughout the research, first during the focus groups and medication mapping exercises, then during photo walkabouts, as emergent themes were introduced and critically discussed in the second focus groups, and later

when findings were read and critically assessed by participants as formative analysis. Participants shared ideas about how they could use these study findings to guide their practice after study completion and as they started an innovation and improvement project entitled The Productive Ward: Releasing Time to Care ™ (NHS Institute for Innovation and Improvement, 2010) whereby they examined all areas of their unit to improve work processes and eliminate barriers to work. Participants were encouraged to use these research findings in ways that fit with their practice on their unit.

A copy of my final bound dissertation will be given to practitioners on this hospital unit, to the provincial nurses' association, and to the University of Alberta Health Sciences Library. Research findings will be presented at conferences, in relevant clinical classes that I teach, and submitted as manuscripts for publication in peer reviewed nursing and health care journals, with a readership of nurses in clinical practice, teaching and research, policy and decision makers, and experts in safety in health care, within six months of program completion. An outline of this study was shared with fellow PhD candidates, and select findings will be posted on my faculty website and my supervisor's website. The aim of these diverse knowledge translation strategies is to create multiple forums where ongoing discussion, validation, questioning, and application of the findings can be facilitated.

In chapter four, I present my findings in six themes. Consistent with citizen science (Marck, 2006), findings as quotes, photographs, and field notes as data were collected and analyzed throughout the study as an iterative process to

generate knowledge; these were shared with community practice members who actively participated in this study in this context. Preliminary linkages are made between my findings and some findings documented in literature. In chapter five, I further discuss findings and implications of findings and offer suggestions for practice, policy, education and further research based on my findings.

Chapter Four

Findings

In this research, I sought to develop understanding about medication safety by exploring supports for and barriers to medication safety on a complex hospital unit with practitioner participant members of a hospital community. My main research question was:

What are the potential supports for and threats to ensuring medication safety on an acute care hospital unit? Subsidiary questions were:

1. How do participating nurses (RNs and LPNs), pharmacy workers, and decision makers describe their current system and processes with respect to medication administration safety?
2. What elements in their present environment do participants identify as contributing to medication safety on their unit?
3. What elements in their present environment do participants associate with near misses, medication errors, preventable adverse drug events, or other medication-related harms?
4. What potential supports for and threats to medication safety are observable on the participating acute care hospital unit?
5. From the knowledge generated in this study, what changes to their medication administration systems, processes, unit practices, policies, and or unit environment do participants identify as feasible and desirable to enhance medication safety?

Data were collected over a period of eight months with participants in two sets of focus groups (FG), four photographic walkabouts (PW), and from field observations (FO) recorded in field notes. In the second set of focus groups, photographs taken with participants and emerging research themes were shared to elicit participants' responses, reflections, and ideas for medication safety improvements. Participants shared their insights, reflections, and advice about medication safety with coworkers, promoting adaptive learning and growth and generating knowledge through the study. Data analysis was an iterative process: I examined each datum as collected, reviewed, questioned, and compared data from this complex setting to current literature. I wrote memos describing codes as these emerged, and discussed codes with participants as research stakeholders and my supervisor, and watched for ways codes fit together to form categories. Codes and categories were fluid as my analysis proceeded and as themes became apparent. Themes were critically questioned and discussed with participants. I continued to reflect about themes as participants exchanged ideas about ways to improve medication safety in this setting.

Findings are presented as six themes that illustrate my understanding of supports for and threats to medication safety on this hospital unit as gained with participants. Themes discussed here include (1) unit structures shape medication safety; (2) medication system design is a complex matter; (3) embedded accountability permeates practice; (4) unit culture affects medication safety; (5) practitioners use workarounds when barriers to safety are encountered and anticipated; and (6) practitioners envision ways to improve medication safety.

Theme One: Unit Structures Shape Safety

Participants pointed out built-in and enduring unit structures that they associated with medication safety, including the structural layout with patient spaces and hallway work stations, medication equipment, and storage areas. Participants regarded many structures as medication safety supports; however, participants regarded some unit structures with trepidation, due to past medication errors, near misses, and preventable adverse medication events.

Unit structures. The entrance to this unit was in the upper left corner of the unit floor plan (see Figure 4.1). There were 27 patient rooms on the unit perimeter that open onto a racetrack shaped unit hallway linking patient rooms to the interior core with unit communication, patient therapy, and service areas. A nurse participant explained that private patient rooms reduced hospital acquired infections for patients, but nurses worked and travelled extensively in unit hallways seeking supplies for patient care rather than caring for patients, which posed an opportunity cost to medication safety:

> *We often do our nursing work in the hallways, like looking at medication orders, and preparing and administering medications from a medication cart. The configuration of this unit influences medication safety as,… while we appreciate private rooms reduce the incidence of hospital acquired infections, …there are long distances to travel when a medication is needed but missing for patient care or a nurse needs to consult with someone about a medication. (PW4)*

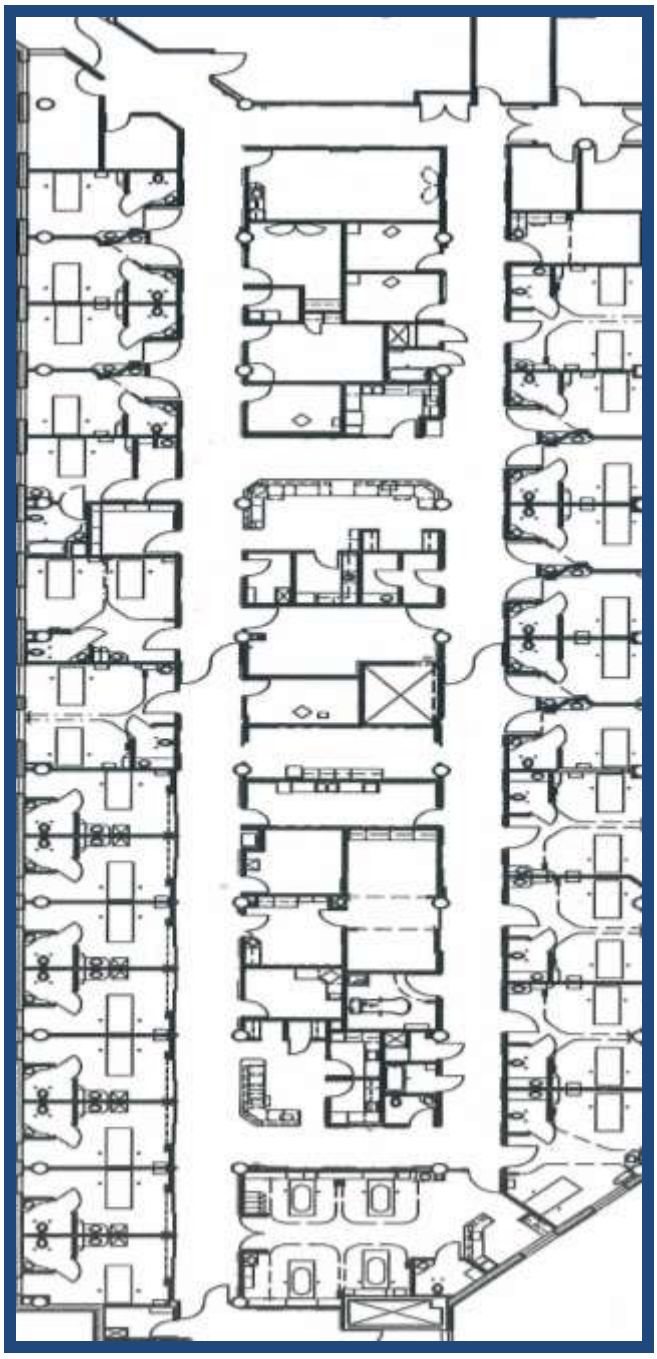


Figure 4.1 Image #111 Unit floor plan

Another nurse participant explained that the physical layout of this unit was a barrier to medication safety when nurses had to run for medications. Nurses travelled long distances, communicated with others,

and could be distracted from work in unit hallways, as this nurse participant described:

> *It can be kind of a pain to go run and get it [medication] if you don't have it on your medication cart, and if you have to go way down the hall you often leave the medication cart standing there when you go. (FG1)*

Nurse participants requested we photograph a medication cart in the unit hallway (see Figure 4.2), to bring attention to "our nursing work in the hallways" as discussed by a nurse participant in Photo Walkabout 4:

Figure 4.2 Photograph #35 Medication cart, nurses' station, unit hallway, PW 1

> *This area [see Figure 4.2] shows one of the two main hallways on our unit. Much of our work and definitely our communication about medications happen here in the hallway. There are lots of people and potential distractions, and the work desk and our cart gets quite cluttered as the work day goes on. (PW1)*

Unit structures included three fold down shelves fastened to walls outside patients' rooms, which nurses used as work stations. During a field observation, one RN participant explained that these shelves were installed and supported medication safety as nurses could position themselves and their work areas close to their assigned patients:

> *When this unit was initially put in service for patient care, the nurse manager at that time fought to have hallway desk areas for nurses. Fold down shelves were built and installed to place our (nurses') work stations close to patients' rooms. We wanted to be close to patients to monitor patients and medications' effects. (FO11)*

Nurse participants were observed preparing medications in unit hallways at stations and medication carts, and administering medications to patients from carts in hallways, amidst many other events happening in hallways. This suggested that these nurse participants were "stacking" (Ebright, 2010, p.1) their cognitive work with patients' medications amid their other patient monitoring and care responsibilities. During field observations, a constant kaleidoscope of events occurred in unit hallways, some events interrupted nurses' work with medications, such as patients' emergencies or co-workers' requests that demanded practitioners' attention. Following interruptions, nurses tried to refocus attention

on their patients' medications or risked making mistakes in medication administration activities. Nurse participants explained how nursing in the hallways invited interruptions:

> *We are nursing in the hallways. I don't mean that nurses shouldn't be close to their patients, we should be, but we are so prone to interruptions in the hallway, and we are supposed to maintain patient confidentiality, but we are out in the open. (FG5)*

> *So your station and cart is in the hallway and we want to be close to the patients, but it's just, it could be difficult for safety when you are out in the hallway. Like, it can just be the interruptions, and being subject to distractions, sometimes we are too accessible to everybody, and we can't even think. (FG5)*

Nurse participants identified work interruptions were barriers to medication safety on this unit, as they could not control interruptions as they worked in unit hallways, which could influence their ability to critically think about medications. Interruptions and distractions were identified as causes of medication errors by several authors (e.g. Bennett et al., 2010; Biron et al., 2009; Conrad et al., 2010).

One RN expressed her view of how the unit layout influenced medication safety as she came from a patient room and went to a medication cart during a field observation. She said "Docusate [a pill] just hit the floor in Room 7, so I need to find a new one to give to that patient. A problem is we are always dodging carts and people in our hallway" (FO6). This nurse indicated that objects and humans in unit hallways hindered her from finding a medication for a patient to replace a pill that was dropped. Her comment reflected the intense activity in unit

hallways, which were nurses' usual work areas. Environmental activity and interruptions were identified as factors that affect nurses' medication administration and medication safety efforts by other nurse scholars (see Eisenhauer et al., 2007; Elganzouri et al., 2009).

On several occasions, I noticed patients were admitted to a bed in a unit hallway, when all available patient rooms were occupied; a practice that added to hallway activity. One Saturday evening, a seriously ill patient was being resuscitated in a patient room towards the back of this unit, at the same time the nurse in charge received a telephone message from the hospital admission supervisor advising that two patients were being sent to this unit to be cared for in beds in hallways. This nurse explained to me that the hospital emergency department was overcapacity, so decision makers directed nurses on units to accommodate and care for extra patients in hallway beds. Nurses decided which area of the unit hallway to place a patient, and a nurse from the nearest patient assignment area, or Bay, was assigned to care for additional patients in the hallway. To ensure medication safety for assigned patients, this nurse participant spoke of caring for patients in hallways and fitting a patient's medications to a medication cart:

> *Often additional patients are admitted to our unit when we have no available rooms, so these patients are put in beds in a hallway. This gives new meaning to us nursing in the hallways, and how do patients feel? These additional patients are assigned to a nurse on the Bay adjacent to their bed in the hallway, and their medications are added to the cart for that Bay, wherever they can fit. (FO19)*

The risks to medication safety with overcapacity patients in hospital unit hallway beds was discussed in an article where a nurse author advises "do not put medication safety 'on hold' with boarded patients" (Paparella, 2010, p.347) admitted and held in emergency department hallways.

A nurse participant pointed out that essential unit structures and supplies located close to where nurses cared for patients supported medication safety, for instance sharps containers placed in patient care areas and on medication carts:

> *Supplies that support medication safety are located close to where they are used. A sharps disposal container is in every patient room and on every medication cart, so that people don't have to go extra miles with a used sharp. So after drawing up or administering medication a needle can be disposed of right there. (FG3)*

To recap, nurse participants viewed unit structures that supported medication safety included hallway nurses' stations with medications and supplies located close to patients. Nurse participants indicated that sometimes the unit layout and the location of their work stations left them open to risks they could not control such as hallway traffic, travel, and interruptions; participants identified these as medication safety risks. Organizational decision makers occasionally placed patients in hallway beds on this unit as a place in which to accommodate patients. Nurse participants stated this organizational practice diminished a nurse's ability to ensure medication safety for patients by increasing the number of patients and medications for which each nurse was responsible.

Medication storage. This unit's medication room (see Figure 4.3) served as a main locked and secure storage area for medications and supplies, which supported medication safety. The cluttered state of the medication room was seen as a barrier to medication safety, as noted by a nurse participant, who commented that clutter sometimes deterred nurses from preparing medications in this room:

> *This is our medication room. We keep our main stock of narcotics in a locked cupboard in this room, and a little bit of supplies. Having a locked room does protect our supplies from "going wandering", but it does get quite cluttered in this room as well. So we basically use this room just to get our meds out of the fridge and our narcotics out of lock-up, rather than for mixing up and preparing medications. (PW1)*

Figure 4.3 Photograph # 11, Main medication room, PW1

A nurse participant remarked that storage of non-medication items in this medication room was a barrier to medication safety, as clutter hindered nurses' access to medications in the refrigerator:

> *It's become a secure place to store everything like the bladder scanner, dressing sets, sheepskins. Well lots of units might like that bladder scanner, or other stuff, even that WD-40. Yeah, storing all that stuff in a secure place is a barrier for us getting to the fridge, it's all in the way, and it's cluttered. (FG5)*

In this medication room, medications in the refrigerator were not easy to locate or identify. A participant pointed out vials of Heparin (an anticoagulant), Insulin (a hormone), and assorted suppositories were kept together in bins on the refrigerator door:

> *We keep some stock medications in the refrigerator in the main medication room. We have the Heparins in one blue bin on the fridge door, and the other blue bin contains all types of Insulin, and it looks like suppositories, are kept here too. (PW1)*

Several participants in a photo walkabout explained that a medication safety risk was nested in the way a mixture of unlabelled and poorly labeled medications were stored on the refrigerator door (Figure 4.4). Nurse participants expressed that there was a risk to grab the wrong medication from this mixed up assortment of medications:

> *I see that neither the Insulin nor Heparin, they may be in separate bins, but still they are not labeled. They are side by each with no label. If you were in a hurry, you could be grabbing the wrong one, and that is dangerous. (FG7)*

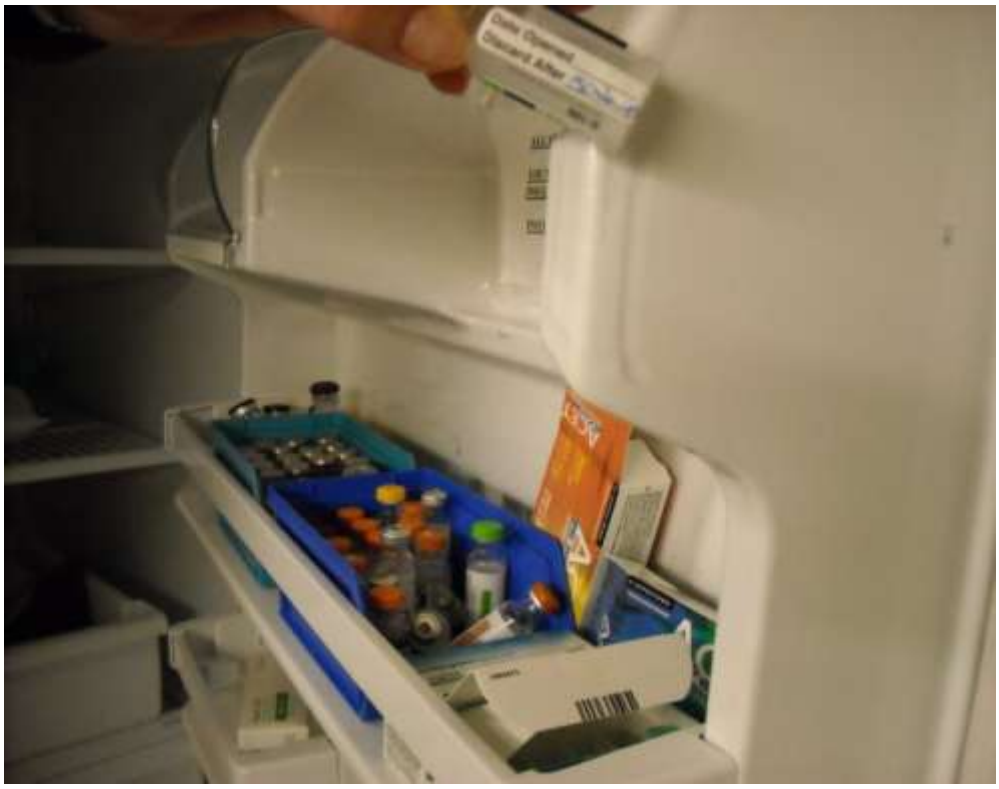


Figure 4.4 Photograph # 13 Stock medications stored on refrigerator door, PW1

> *Some insulin vials in the fridge are already open, so hopefully the expiry dates are written on. And the two open suppository boxes… if I just grab what I think is the right suppository from a box, it might not necessarily be the correct suppository. (FG8)*

A multitude of medications were stored in the main cavity of the medication room refrigerator, such as Heparin in pre-drawn syringes, and pharmacy-prepared antibiotic doses. Nurse participants identified that the way all medications were stored in their unit medication refrigerator was a medication safety barrier, as medications could be difficult to locate:

> *The whole ward is clumped here for medications. All the IV stuff goes in this fridge for the whole ward. So everybody's is piled together, and if you*

forget the person's name or the drug, who knows what you might be pulling out of there, all that stuff is distracting. (FG5)

Figure 4.5 Photograph #14 Medications stored in refrigerator cavity, PW1

There is no light in the fridge, so you can't see anything; you have to pull out the entire bucket of IV and pharmacy prepared meds, which is behind that strip of Heparin syringes that someone is holding, to find what you are looking for, or what you need for meds. It's hard to find things in there. (FG5)

In contrast, a nurse participant pointed out medications stored neatly in labeled shelves and small drawers (Figure 4.6) in the medication room. Stock medications were ordered and sent from pharmacy to the unit once weekly, and a unit clerk placed medications in these labeled shelves in the medication room. A

nurse participant requested that we take a photograph of these neatly arranged medications, which she asserted was a support for medication safety:

Figure 4.6 Photograph # 25 Stock medications, medication room cupboard, PW 1

Nurses transferred stock medications from these shelves to medication carts, and some nurse participants stated that having stock medications on carts (Figure 4.7) supported medication safety. However, some nurse participants found the way these medications were stored on carts posed a medication safety risk:

> *Well, as you can see here we keep the injectibles like Gravol and Stemetil in the same drawer with Nitro-glycerin spray. Then there are nebulizers in the same drawer as the suppositories. I think it is just a case of "where would you put them so they are handy, eh?" (PW1)*

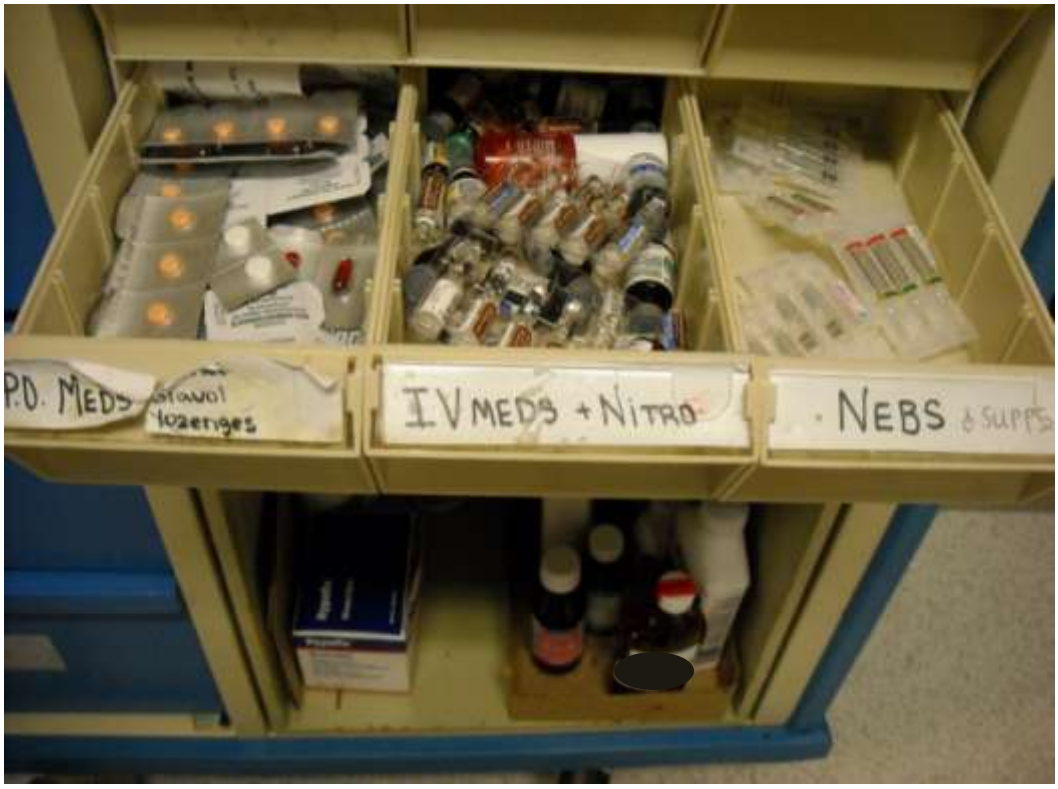


Figure 4.7 Photograph # 31 Stock medications on a medication cart, PW 1

One nurse participant in a field observation characterized medications stored this way (Figure 4.7) as "It's an accident waiting to happen with everything together like that"(FO5). Another nurse participant described her frustration when searching for a medication here:

> *Like we have our drawer with our p.o. [oral] meds and our IV meds, and suppositories not so much, but like everything is just bumped together. Like jumbled, so you spend time looking for something you need like Maxeran, and eventually you can't find it. Like there's no order to anything, everything is just thrown in there, if it's there, it's there, if not, go look for it somewhere else. (FG5)*

Another nurse participant recalled a medication error that she associated with this storage, and took the opportunity during a photo walkabout to tell her medication error story to other participants:

> *I wanted you to take a photo of these stock medication drawers on our medication cart, too. I reached into the drawer once to get a Tylenol for a patient, and came out with a Septra [Co-trimoxazole] tablet. And do you want to know the kicker? I gave that Septra tablet to the patient, not realizing until after that it wasn't Tylenol. We have to watch that we don't make errors with meds stored like this. (PW1)*

Participants identified that medication storage on their unit significantly influenced medication safety, for instance the well organized stock medications stored in labeled shelves and small drawers in the medication room supported medication safety. Many participants recognized how the well organized stock medications in shelves contrasted with other medication storage areas on the unit that were messy or disorganized with cluttered, unlabelled or un-separated medications. Messy medication storage areas were viewed as medication safety risks. In literature, researchers identified that cluttered medication storage was an environmental antecedent for medication errors (see Conrad et al., 2010); and in one study, nurse participants discussed cluttered medication storage was a risk to medication safety (Marck et al., 2006a). On this unit a nurse participant emphasized that messy medication storage was "an accident waiting to happen" (FO5) for nurses on this unit. Interestingly, nurse participants asked me to photograph medication storage areas and objectified these areas as

medication safety risks. A nurse participant asserted that nurses worked with medications provided in this system, and if a medication was not visible where they looked, nurses "go look for it somewhere else" (FG5). In addition participants discussed how available medication equipment affected medication safety.

Medication equipment. This hospital used a cart-based unit dose medication system, therefore medication carts were essential system equipment. Patients' medications were brought to the unit in cassettes or small drawers and placed on carts by pharmacy technicians during daily medication deliveries. Nurses moved mobile carts adjacent to patients' rooms when they administered medications. Five medication carts were dissimilar in design, and stock medication supplies were in different locations on each cart. Nurse participants asserted that dissimilar carts and cart contents were medication safety risks and cluttered cart work surfaces were a distraction:

> *Medication carts allow us to take medications to patients at the point of care. Five different medication cart configurations on this unit can pose a potential barrier to medication safety as nurses sometimes hunt for supplies in different places on carts. And as the cart's small work surface gets cluttered, which it inevitably does, this creates a distraction. (FO20)*

> *Everything is in a different spot in every cart. We might be assigned on a different team each time we work. So part of coming to the cart after report, is orientating yourself, not only to what you need to catch up on, but also to what's different with this cart. Like where is everything? (FG5)*

Nurse participants mentioned that some medication carts were brought to this unit from another hospital. But regardless of where carts came from, dissimilar configurations of carts and contents frustrated nurse participants, who identified these as medication safety risks:

> *We still have some of the old med carts brought over from a hospital that closed in 1998. There's no labeling on some carts, its nonexistent; you are pretty well going through every stinking drawer to find what you are looking for. And half the people here don't even know that we have stock of certain things in the medication room, there is nothing to say this is in this cupboard, and this is what is on the cart. (FG5)*

Another nurse participant in this focus group remarked that nurses just "work with what they have", indicating her understanding that nurses accept that they worked with medications and supplies someone else provides and arranges, meaning equipment and supplies were simply there:

> *I just think that sometimes we have certain equipment and nurses work with what they have. So it just happens to be whoever's on whenever that med cart arrives, that person, whoever filled the cart, is the one who deems hey, well, all the meds are going this way, all the pens are there, all this is there, all that is there, whatever. Then it has to be a nurse that stocks medications on the cart, like puts the stock medications in the drawers, and they just follow along with what's there, maybe dump them in. (FG5)*

In a photo walkabout, one nurse participant mentioned that nurses had discussed standardizing location of supplies on medication carts, although this had not yet occurred at the time Figures 4.8 and 4.9 were photographed to illustrate different cart designs:

So we have a cart for each bay, with five bays at the moment. We (nurses) have talked about standardizing each cart so that it doesn't matter where you work, all the same supplies would be at your fingertips. We just haven't done that yet. (PW1)

Pharmacy technicians brought and placed patients' medications in cassettes in standardized areas on medication carts once a day. There was limited space on medication cart, and nurse participants stored medications and supplies elsewhere on carts. Medication cassettes were seen in the photograph of the medication cart on the right (Figure 4.9) as two rows of eight small drawers.

Figure 4.8 Photograph #64 Medication cart, Bay 4, PW4

Figure 4.9 Photograph # 63 Medication cart, Bay 3, PW4

Other medication equipment included IV pumps for patients' fluid and medication infusions. Pumps and IV tubing for use in hospitals were purchased through a provincial purchasing contract from one supplier. Nurse participants

stated medication pumps supported medication safety when these were available and functioned to infuse medications as programmed. Conversely, when pumps were not available or malfunctioned, these posed a barrier to medication safety. Intravenous pumps as medication equipment (see Figure 4.10) were linked to hospital medication system design. A nurse participant explained IV pumps were secured in a locked equipment storage room to ensure that a pump was available when needed, as sometimes people from other units borrowed unsecured pumps:

> *There are two types of IV infusion devices or pumps that we use to administer IV fluids or medications to patients. These are kept in a locked storage room on the unit as these pumps are used throughout the hospital and sometimes they are taken or borrowed by other units. And then we don't have them for our patients when we need them. (PW1)*

Other researchers noted that it was not uncommon for employees from other units in a hospital to come to borrow equipment and supplies when equipment was unavailable or scarce on their unit (Tucker & Edmondson, 2003).

Figure 4.10 Photograph # 45 IV infusion pumps in storage room, PW1

Several nurse participants discussed problems that they sometimes encountered when they set medications to infuse through a pump with tubing, because pumps malfunctioned or tubing plugged. Plugged tubing prevents medications and infusions from infusing as programmed, as discussed by several researchers (e.g. van den Bemt et al., 2004; Williams, 2008). A nurse participant shared ideas and strategies to unplug tubing and correct infusion failures in a focus group discussion with peers:

> *Usually I take the syringe with medication out, then put pressure on the plunger of the syringe while it is still attached to the tubing but not to the pump or the patient, to try to clear the sediment out of the tubing. I put it*

back in the Bard, turn it on, if it doesn't work, change the tubing, or try a different Bard, 'cause they [patient] need that med. (FG2)

Other socio-technical medication devices provided for use in hospitals according provincial legislation were protective needles and needle-less IV tubing. A nurse participant stated these devices support medication safety as nurses experienced fewer needle-stick injuries, and fewer work interruptions due to lost-time injuries than before these were introduced:

This might be medication safety for patients. There is a law that requires we use protective needles with a guard that comes up over the needle after use. In the past, we used to poke ourselves with needles a lot more than we do now. (FG2)

Participants regarded available medication equipment as mostly supportive of medication safety, for instance medication carts were supports for the unit dose medication system and medication infusion pumps supported safe medication administration when these are available and functioned appropriately, similar to Paoletti et al.'s (2007) findings. Equipment could be regarded as a barrier to medication safety, such as non-standard medication cart styles with disorganized cart contents, as nurse participants associated these with lost time searching for medications and supplies. Participants viewed absent or malfunctioning medication infusion pumps, and easily plugged tubing as medication equipment that did not support medication safety, in fact these were often viewed as safety risks. It was interesting to note that nurse participants tried to unplug tubing, and exchanged tips about how to unplug tubing with peers. Nurse participants did not

control the types of medication equipment available for their use, although they spoke of trying to control their practice with medication equipment to ensure patients received medications as ordered. Vincent (2009) and Iedema (2009) assert socio-technical devices can support patient safety when practitioners can control and adapt their practice with each device in different patient situations.

In summary, this theme of unit structures evolved as nurse participants assessed and discussed various aspects of the unit's structures and physical layout, medication storage spaces, and equipment in regards to whether an area supported or posed risks to medication safety, or both. Unit structures that nurses perceived as supportive to medication safety were hallway nurses' stations which located nurses' work close to patients, sharps disposal containers close to their work areas, well labeled medication storage, and available medication equipment that functioned effectively. Paradoxically, nurses saw unit hallways, which were pivot points for medication administration, presented real and potential barriers to medication safety when they considered the long distances they travelled, unrelenting traffic and work interruptions that happened in hallways as they checked, prepared, and administered patients' medications. Nurse participants asserted that nursing care for patients and their medications were balanced precariously when additional patients were placed in hallway beds, and regarded this organizational practice of placing extra patients in hallways as a patient and medication safety risk. In addition, nurses identified and disparaged crowded, cluttered, and unlabelled medication storage areas, and unlabelled medications that were stored all together as real medication safety risks. When medication

equipment (pumps and tubing) failed and tubing plugged, medication safety for patients was threatened.

Nurse participants expressed that someone else made decisions about unit structures, and as such they were not included or in charge of deciding where to store medications in the medication room and on carts. This belief was communicated as "whoever filled the cart, is the one who deems hey, well, all the meds are going this way" (Nurse Participant, FG5). Participants spoke of needing to change some medication storage areas. However, it seemed that participants saw the need for change, but did not feel they owned the problem, nor did participants feel empowered to make changes to medication storage. In effect, nurse participants identified that they did not control unit structures related to medication system design, such as medication carts with medications and supplies located wherever they fit, or the arrangement of stock medications, or the type of pumps and tubing that were used. Medication safety supports and barriers that participants associated with medication system design are presented in the next theme.

Theme Two: Medication System Design is a Complex Matter

Participants recognized medication system design had a pervasive influence on medication safety and identified a variety of areas where medication system design supported and areas that posed barriers to medication safety. The term medication system design in this context refers to the way the medication system was organized and operated to provide medications to patients in this hospital. A component of medication system design includes activities to support the cart

based unit dose medication system such as procedures for processing, entering medication orders, and providing medications to hospital units. Additional components included medication security structures and activities, medication information systems, and a provincial medication reconciliation system.

Cart based unit dose medication system. Practitioner participants viewed the unit dose medication system as mostly supportive of medication safety, as processes were in place to enter medication orders into a pharmacy computer system and provide medications to units from a central pharmacy. Pharmacy staff dispensed medications to units in single and multiple dose forms, when pharmacy was open during daytime hours. Saginur et al. (2008) reported that unit dose drug distribution systems were a healthcare technology widely used in Canada to improve medication safety in hospitals; however, it was not clear if the hospitals surveyed provided all medications as unit doses.

Acutely ill patients were admitted to this tertiary hospital and medications were prescribed for patients anytime of the day or night, which meant medications were ordered for patients when this hospital pharmacy was open and when it was closed. When medication was ordered for a patient, delivery of the medication to the unit where the patient was located from pharmacy could take up to three hours during the daytime and this time gap could pose critical risks to medication safety for patients needing prescribed medication. Patients could be exposed to AMEs, such as unnecessary pain waiting for specific pain-relieving medication. A nurse participant discussed how nurses reviewed and processed medication orders, and obtained medications from pharmacy so these could be administered to patients:

The order's written, so we get the order processed by the unit clerk or we [RNs] do it after we check that the order is correct. To process an order on a chart, we rip off a copy of the physician's order sheet [a non carbon copy] and put it in the pharmacist's basket, or if it's after a certain time we fax it to pharmacy. We process medication orders all the time, so we might fax orders when there is no one in pharmacy, like when they are closed. During the day though, it sometimes takes 2-3 hours to get a medication that is ordered up on our unit after we process the order. (FG1)

Pharmacy technician and nurse participants recognized the risk to medication safety when patients' medications were needed, but missing, with this unit dose system. Pharmacy technician participants recognized the increased acuity of patients admitted, that medications were needed at all hours of the day, not just during the hours pharmacy was open, and that there were "a lot of missing meds":

People are way sicker by the time they are admitted to the hospital, and more medications are ordered for each patient than there used to be. Patients are admitted and need medications 24 hours a day, and we [pharmacy] are only open about 12 hours a day. There's bound to be medications that are needed that are not available right away, and when we are not open. (FG4)

Pharmacy delivers medications in cassettes to units once a day, and they bring IV meds and put these in the fridge all together in a bin, so in an acute care hospital, there is bound to be a lot of missing meds, because pharmacy only delivers patients' meds to the unit that were put into cassettes twenty four hours before they are delivered. (FG7)

Pharmacy technicians delivered medications as unit doses in individual packages to hospital units in cassettes (see Figure 4.11). A nurse participant requested a photograph of medications in a cassette describing "In this open cassette in a medication cart, we see oral medications in small individual packages [unit doses] as they are sent up from pharmacy each afternoon" (PW1)

Figure 4.11 Photograph # 42 Unit dose medications in a cart cassette, PW1

When medications were not available for patients at the time these were scheduled to be administered, this was seen as a medication safety risk. Several nurse participants discussed that missing medications could trigger a variety of consequences that affected current patients, and, potentially, other patients awaiting a hospital bed. Nurses took actions to prevent AMEs from missing

medications by phoning pharmacy for patients' medications, and nurse participants exchanged knowledge about consequences of missing medications:

> *Many times when nurses find that medications are missing in this unit dose cassette system, they have to choose what to do to provide the best patient care. Nurses phone pharmacy and get the pharmacy voice mail where the very first option on that message is for missing meds, so it is not as if missing meds are an unknown concept. So that can really have bad consequences for a patient in this system. (FG7)*

> *So medication safety is tied to timely access to medications for patients, it really is, because if it takes three hours to get a pain relieving medication like Toredal, you might not be able to control the patient's pain, and the patient suffers. (FG8)*

> *And what about when the antibiotic is not available here on the unit, and by the time you get it, not only has the patient's antibiotic blood level dropped, but you will be looking at adjusting future doses as well to get the timing right. (FG8)*

> *Missing medications can even delay a patient's discharge if you are waiting for missing medications to give a patient the rest of the antibiotics before they are discharged. This impacts others too, when a patient is waiting somewhere for that bed, but my patient won't be ready to leave today. (FG8)*

These nurse participants expressed frustration as they discussed consequences of missing medications that could not be administered to patients and threatened medication safety. Oishi (2009) and Turple et al. (2006) assert that missing medications, sometimes called pharmacy discrepancies, are inevitable when a central pharmacy provides medications to hospital units once

a day with a unit dose medication system. Another medication safety risk that nurse participants identified was embedded in this unit dose medication system was associated with nurses preparing high-alert medications on their unit.

High-alert medications are "drugs that bear a heightened risk of causing significant patient harm when they are used in error" (ISMP-C, 2008, p.1). High alert medications such as narcotics, Insulin, and anticoagulants including Heparin were stored undiluted on this unit. Nurses calculated doses, prepared, and administered high alert medications as ordered; the inherent medication safety risk with high alert medications for patients can be compounded when nurses rush to mix a high alert medication accurately, which they often do in urgent or emergency situations. As this nurse participant described mixing a high alert medication that was needed urgently by a patient, the tempo of her voice accelerated as she spoke:

> *Stat meds usually are not mixed by pharmacy. You receive a vial and or pills and the nurse has to prepare the dose of the medication in the form that it is ordered from the standard that is supplied, which may or may not be the correct dose ordered. For example, there might be a stat order for five thousand units of Heparin IV, but the medication comes from pharmacy undiluted in three different concentrations in vials. The nurse must pick the right concentration and calculate how much of the medication to draw up and how much diluent is needed, and try to hurry and prepare the medication and administer it after establishing a patent IV access and finding a pump to infuse the medication. (FO4)*

Another nurse participant spoke more pragmatically as she described how nurses mix and administer high dose medications from medications kept

as stock. She acknowledged the risk to medication safety, and risks for medication errors when some medications were supplied as unit dose in this system, while high alert drugs must be drawn from multi-dose vials and diluted:

> *Nurses are required to calculate and draw up high alert medications for patients on the unit. Potential medication errors could occur when a nurse is not used to mixing medications, because many medications are supplied in already prepared single doses in this unit dose system. Nurses have to mix several high alert medications and they take the risk every time of making an error with a potentially lethal drug. (FO15)*

To summarize, nurse participants identified processes that supported medication safety associated with the unit dose medication system, such as the way handwritten medication orders were processed to prompt the delivery of patients' medications to this hospital unit. Barriers to medication safety with this unit dose system included that some medications are dispensed as individual doses from pharmacy, while several high-alert medications were delivered to this unit in multiple dose containers, which nurses often prepared for patients in emergency situations. The most prominent threat to medication safety nested in this system, as vehemently pointed out by participants, was the inevitability of missing medications when these were needed, because pharmacy did not provide medications as ordered, 24 hours a day. Medication system design encompassed provisions for medication security, as discussed next.

Medication security. Medication security was a term used by participants to show that medications were kept safe and accounted for in storage and distribution systems, free from tampering, loss, or contamination. There were complex in-hospital systems to ensure security of medications. Pharmacy technicians worked inside the walls of a secure department preparing and distributing medications to units based on orders that pharmacists entered into a password protected pharmacy computer system. Technicians could be contacted by telephone or fax during working hours, and they dispatched medications as ordered to units with a porter during the day. When pharmacy closed, some medications were available from a pharmacy-stocked locked night cupboard, which a security person could access and provide the medication to a unit as requested, and an on-call pharmacist could be contacted with questions or for medication emergencies. Night time pharmacy services were provided in other hospitals through medications in night cupboards (Oishi, 2009) or by outsourced telepharmacy services (Keeys et al., 2002). Pharmacy technicians maintained a secure system in the pharmacy of medication storage, handling, and distribution, which supported medication safety. A pharmacy technician participant stated "We keep narcotics and controlled drugs locked up and keep records of all narcotics used or wasted in the hospital for two years, according to law." (PW3).

Narcotic and controlled medications were secured on this patient unit in locked storage areas to which nurses carried keys. One nurse participant pointed out "Pharmacy techs bring up narcotics and put them into the unit's central narcotic cupboard, and they sign it onto your sheet to record that you have these

narcotics" (FG1). Nurse participants documented withdrawal of narcotics or controlled drugs from the locked areas on a pharmacy designed and provided documentation form to maintain medication security. A nurse participant explained that nurses transferred narcotics from the main locked cupboard to locked narcotic drawers on a medication cart only as needed, because nurses did not want to carry or account for extra narcotics on carts:

> *It can be kind of a pain to go run and get a narcotic if you don't have it on your medication cart, and then sign it out of the main narcotic cupboard, but because we have to count and sign for narcotics each shift, I don't want a whole bunch of extras in my cart. (FG1)*

Nurse participants expressed concerns that they could not guarantee the security of supplies located on medication carts in unit hallways, as carts were mobile and nurses were often away from medication carts. Medications and supplies on mobile medication carts were accessible to anyone with a penchant to take things. One nurse participant explained "There is easy access for a patient or anyone to take medications out of drawers or off the top of medication carts in the hallways; yesterday a visitor was helping themselves to stuff off this cart" (FG8). Pharmacy managers and hospital employees knew of this system vulnerability, and nurses were instructed to call hospital security if medications or supplies were pilfered from carts. This nurse participant described how she felt responsible to safeguard medications on carts:

> *Security of medications on carts is a problem. Like how many times when the (med) cart is out in the hallway and you are in a room do*

people come and swipe stuff out of the cassettes, and help themselves from the cart, you've got a cart full of stuff that anybody might get into and do whatever. Yeah, I even saw somebody steal the alcohol hand sanitizer. (FG5)

Security of medications included responsibility to maintain and ensure the integrity and cleanliness of medication preparation surfaces on medication carts. A nurse participant contrasted how she prepared medications on a medication cart in a hallway to the way pharmacy technicians prepared medications under controlled conditions in a dedicated room in pharmacy; she voiced her assessment that cart cleanliness and medication integrity could be compromised, and medication carts could be contaminated as nurses moved carts about the unit:

In pharmacy there is that medication room where they mix IV meds, under controlled and sterile conditions, and we mix IV meds at the cart in the hallway. The cart is just out there and we just leave them. Lately we had all the patients in the four bed put on isolation, because one of the patients in there had MRSA [Methicilllin-Resistant Staphylococcus Aureas], but we didn't find out until later, and everything had to be cleaned, including the medication cart. Meanwhile that cart was in there with those patients, just like we take all our other carts close to patients, and it makes you wonder, doesn't it, about what we can't see that's contaminating those carts and the surfaces where we prepare meds. Maybe we contaminated meds without knowing. (FG5)

A nurse participant pointed out to colleagues that having prepared, patient-specific medications delivered to the unit refrigerator provided a measure of medication security, as nurses could ascertain if that patient's medications were missing or remaining:

Patient's IV medications are stored in the fridge which provides security in three ways: the fridge is in a secure med room, the stability of IV meds is secured in a temperature controlled repository, and it provides a means of accounting for IV meds to ascertain if meds are administered to patients. We had an instance last year when a new nurse failed to give five IV antibiotic doses during one shift, some were signed for, some weren't, and because of the fact that they are delivered for twenty four hours, it was clear to us that these medications hadn't been given, because we counted what was remaining for that patient in the fridge. (FG7)

Both nurse and pharmacy technician participants raised concerns about the physical security and chemical stability of medications placed in a pharmacy drop off box (see Figure 4.12). As mentioned earlier, medication orders were filled and medications sent from pharmacy to units with a porter. The pharmacy drop off box was the spot where porters dropped off medications sent from pharmacy between daily deliveries, and the security of medications left in this box was discussed by nurse and pharmacy technician participants in several focus groups. A pharmacy technician participant expressed concerned about the lack of physical security for medications placed in this box, and a nurse participant stated that nurses could be caught unaware when medication that they had been waiting for was delivered to this box:

This is the pharmacy drop off box, where the pharmacy technician will drop off the medications, so, um that will include the stat meds as well as the routine or 'in between' drawer drop offs. This may not be the safest option, because there is no communication between the pharmacy tech and the nurse when it is dropped off, so that is not ideal for security. We don't know it is there, and it could go missing from the box. (PW1)

Figure 4.12 Photograph #1 Pharmacy medication drop off box on unit, PW 1

A pharmacy technician participant questioned if medications left in a drop off box on a unit were secure, and if someone was responsible to pick up medications left in a medication drop off box, or correct information on a label:

> *That [medication drop off box] is just not safe, period. It is out in the open, unsecured. It's sitting on top of the counter at the main desk, and the open area faces out from the desk, and there is a lot of traffic in front of it. And if a medication is put into the box, whose responsibility is it to pick it up? Like see the label on it: It is not possible to have medications in any box by nine o'clock, and pharmacy closes at 8 PM weekdays so the label is wrong, too. (, FG6)*

This lack of security and communication about medications placed in the pharmacy drop off box left pharmacy technician participants questioning why

they repeatedly sent medications to units, and whether nurses even knew about drop off boxes:

> *Why was this medication sent to this unit, if they didn't even pick it up? Maybe lots of nursing staff don't even know this [pharmacy box] actually exists, cause when they phone for a med a second time, and you say check your bin, and they say 'what bin? Where is the bin?' (FG6)*

These questions uncovered a deeper system issue with this pharmacy drop off box, in that some nurses had given up on guessing when a medication might be delivered to a unit drop off box, or where to check for missing medication. Nurse and pharmacy technician participants alike were dissatisfied with medications left in the drop off box:

> *There is only one box for the whole unit, so if I am down on Bay 2, or 3, or in the 4-bed, I never know when those meds are coming that I called for, and you most likely won't get the meds when you need them. (Nurse Participant, FG5)*

> *So if an IV med is called for and sent up to the ward with a porter, it goes into that red box. A pharmacy person might go there three hours later for something and it is still in the red box. It should have been in the fridge, but it was out of the fridge and the med is deteriorating. If an IV med sits out [of the fridge] for hours maybe it isn't even any good when it is hung for a patient. Or when we get it back down [to pharmacy], to put in our fridge, we recycle it, and we really don't know how long it was out of the fridge. This is not a secure part of our system, because of the unknowns. (Pharmacy Technician Participant, FG6)*

Participants illustrated here that they associated medication safety and security in this system with safe storage, delivery, and accounting for

medications. Participants questioned medication security in some areas, for instance medications on carts were not considered safe from theft and the security and chemical stability of medications placed in pharmacy drop off boxes on units was queried. Interestingly, participants did not view that they had ownership or control over the medications in pharmacy drop off boxes, and this led to palpable frustration when medications were missing and nurse participants had to stop what they were doing to repeatedly check the box, and when pharmacy technician participants saw medications left in a box. Balka, Kahnamoui, and Nutland (2007) reported nurses and pharmacy employees experienced problems with medication drop-offs in another Canadian hospital, although Balka et al. did not report a resolution was developed to this problem. I questioned what would improve medication security with this system; however, neither nurse nor pharmacy participants offered ideas about ways to control problems or improve the medication delivery system. Next, participants discussed medication information systems and medication safety.

Medication information systems: Documentation. Medication information was documented in this system in a variety of ways. Physicians wrote medication orders in patients' charts. A medication order was hand processed by nursing staff as described earlier. A pharmacist's clinical role included entering medication orders electronically to prompt medication label printing in the pharmacy department, pharmacy technicians picked medications as ordered, affixed a medication label to the medication, and set these out to be delivered by human hands to a patient unit. Medication orders were collated for each patient

and printed on each unit on a Medication Administration Record (MAR) once daily. Nurses documented medications administered by hand on printed MARs, patients' charts, and narcotic and controlled drug records.

One nurse participant described documenting narcotic administration in multiple places to fulfill the documentation requirements for a narcotic in this system "I sign manually in 5 places when I administer a narcotic. That's a lot of signing." (FO21) One nurse pondered "why do we still work with 18th century tools [she indicated her pen] when there is 21st century technology? I mean there must be a computer system that we could use to chart and document medications" (FO3). A nurse from the hospital information technology (IT) department suggested an electronic medication documentation system could be available for use in this hospital in the future, as a component of an electronic patient health record. The proposed electronic medication documentation requires that all stages in the medication ordering, processing, and administering system would change to accommodate electronic checks to verify accuracy before a process occurs and the next action can happen. I recorded questions in my researcher's journal, about implications for medication administration and medication safety with an electronic documentation system, such as would there be computer program integration so that resources would be readily accessible to practitioners? I wondered about scanning medication packages at the same time that the MAR and patient's identification bracelet was scanned indicating that the medication was administered. However, the medication was not yet administered at the time of scanning as experts suggest (see Patterson et al., 2006), leading to questions

about medication inconsistencies between the medication barcode scanned and medication actually ingested by a patient. I questioned the accuracy of medication alerts if a medication was labeled incorrectly, was expired, recalled, or the barcode was electronically illegible. I wondered what strengths and vulnerabilities have been identified by practitioners in other areas associated with electronic medication documentation systems. These questions reflect some questions investigated in literature about technology implementation in other pharmacy systems across Canada (see Balka et al., 2007; Saginur et al. 2008).

As mentioned earlier, medications in this system were prescribed, dispensed, administered, documented, and monitored with actions predominantly carried out by human hands. Medication errors were documented in handwritten reports, as required by regional policy. One nurse participant credited the current system of medication documentation as the reason she detected an error she made when she administered an incorrect narcotic with a similar sounding name to a patient by mistake. Medication administration errors are sometimes linked to practitioners' mistakes as they select wrong medication when medications have similar-sounding and look-alike names assigned by drug companies (see ISMP-Canada, 2010; McCoy, 2005). A nurse participant shared her experience of mixing up similar sounding narcotics with co-workers during a focus group discussion, to alert others:

> *Ok, back to signing for a narcotic, um, yeah, it was when I documented that I discovered that I had mixed up Oxycodone and Oxycontin (a longer acting medication) and gave the patient the wrong medicine. I only caught it when I wrote it in the patient's chart. Then I went to check*

the patient a lot, I filled out a form reporting a medication error after I let the doctor know I made the error. Sometimes things happen when you, you're kind of doing something different, but I don't think I would have caught this error if I didn't have to chart it [pause] you know write it out. (FG1)

From this nurse's perspective, this medication documentation system supported medication safety and she recognized her medication error as she documented administering the drug, although other participants questioned the value of redundant documentation, such as having to sign with pen and paper for narcotic administration in five areas. There was discussion about an electronic medication record on this unit, which might complement a province-wide medication reconciliation system. Practitioners informally evaluated the merits of this medication reconciliation system a component of medication system design in regards to medication safety next.

Medication information system: Medication reconciliation. A medication history was electronically available for each resident of the province who purchased prescription medication three months prior to hospital admission. This electronic medication history or patient information profile (PIP) was the basis for a provincial medication reconciliation system. Medication safety was supported when a patient's medication history was checked with a patient on admission, and reconciled by health workers (e.g. physicians, pharmacists, nurses) at transfer points and upon discharge. If a patient's medication history was incomplete or unverifiable (for instance if a patient was non-responsive), medication histories were less supportive of medication safety (see Chevalier et

al, 2006; Johnson, Bryant, Hiteshew, Jenkins, & Sobol, 2010). One nurse participant indicated a poster on the unit that outlined medication reconciliation processes in this system to support medication safety and to obtain the best possible medication history (BPMH) for each patient:

> *This medication reconciliation poster (Figure 4.13) was placed above each medication cart. We review medications with patients at admission, transfer, and discharge to get the best possible medication history. (PW2)*

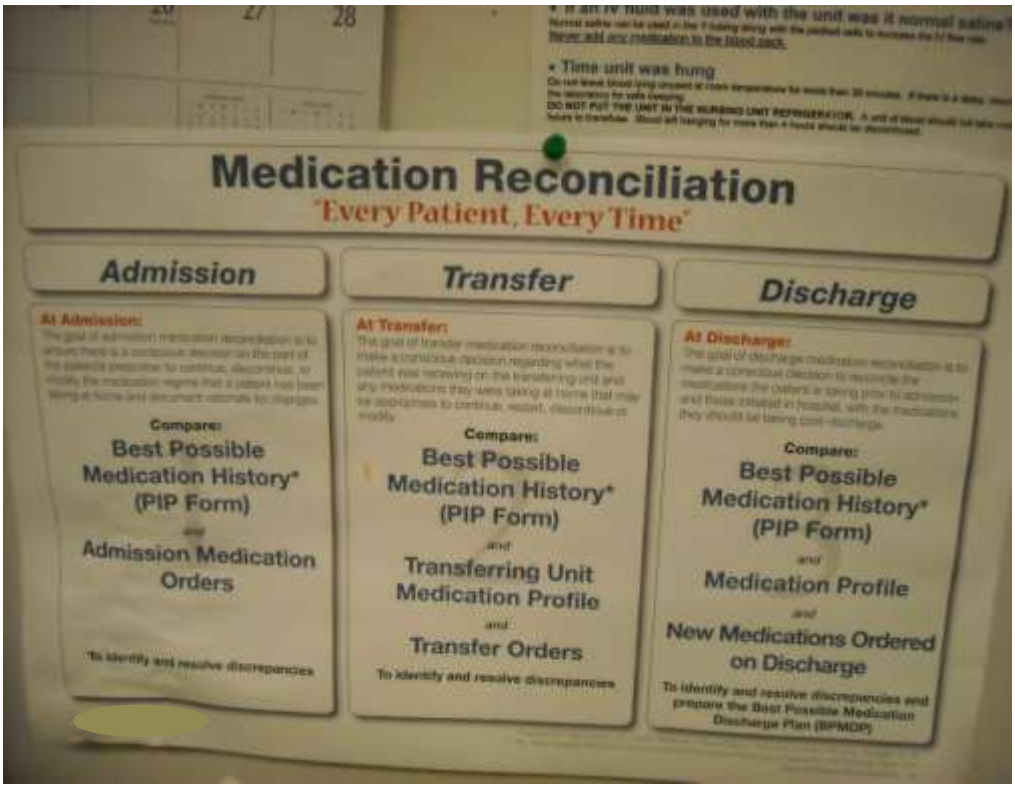


Figure 4.13 Photograph # 30 Medication Reconciliation poster, PW2

Medication safety was supported when health care workers gained information about what, how, and when a patient took medications before coming to the hospital. Participating RNs demonstrated during field observations and walkabouts how they verified and reconciled medication information with a

patient as listed on a PIP (see Figure 4.14), and asked patients about other medications taken before admission, which could affect their health care:

> *We ask patients what route, dose, and how often they take each drug that is listed on the printout. We (RNs) often have lots of questions about why a patient is taking a med. We talk to the patient and try to find out what they were taking, and how often and then put those meds on a physician 'ask list'. (FO7)*

> *We try to get the 'BPMH' with each patient. You know what? This verifies sometimes that 'I know you know best about your drugs, and we would like to work together here'. We ask 'if you have a headache what do you take?' for those sporadic over-the-counter things, and so we try to assess all meds with a patient. (FG2)*

Physicians used medication information available on a printed PIP to order medications for a patient upon admission, and health care practitioners used information on PIPs to reconcile medications with patients throughout that patient's hospital stay. Practitioners tried to assess any new medication information that a patient remembered and wanted to change regarding information initially shared on a PIP. The medication documentation system using patients' PIPs was not regarded as problem free. One pharmacist participant told a story of problems arising from PIPs that posed risks to medication safety:

> *Some problems are actually inherent in the PIP, compared to the old system where the nurse went to the patient and said "what are you taking?" and the patient produced a list and the nurse wrote down the list and took it (list) to the doctor. Problems begin with a PIP when*

> *physicians go back and change things after they say to the nurse "go ahead and give them all their home meds". In that case the nurse does the checking, and signs the medication order for the physician, and then the physician comes back and says "oh no, I didn't want that" and scratches it off. But a PIP is a legal document and it has been processed, and they really can't do that, but they do. Problems with the PIP impacts medication safety for patients, because it can be hard to get them the right meds. (FG7)*

And a nurse participant expressed her frustration with information on PIPs to colleagues in a focus group:

> *Sometimes the PIP is a disaster; I mean the information collected before is just not the same as what the patient says now on transfer to this unit. Then you have to get a doctor to change medication orders based on this different information, but we try not to let them do it on the original PIP. (FG5)*

Chevalier and colleagues (2006) noted similar problems were encountered with medication reconciliation at transfer points in three medical units in another Canadian hospital. For instance, Chevalier et al. reported that nurses surveyed pointed out that patients sometimes did not initially provide accurate medication histories upon admission and later recalled and changed medication information in conversation with health care workers at transfer points when medications were reconciled.

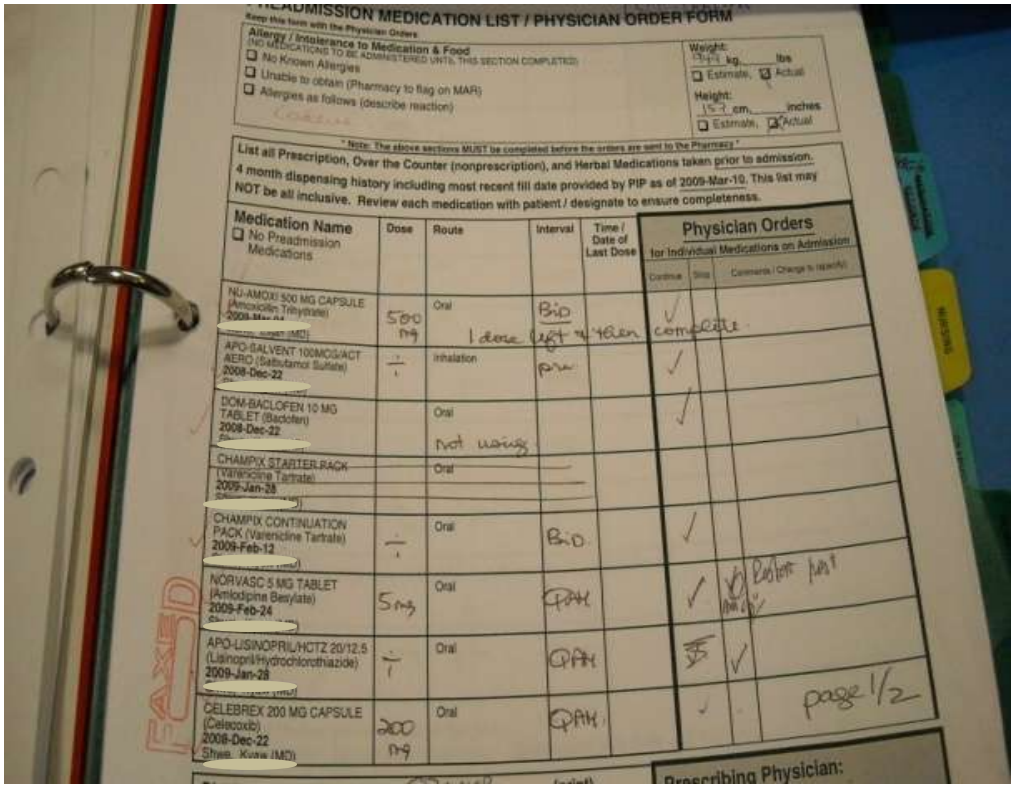


Figure 4.14 Photograph #51 Patient information profile or PIP, PW 1

As these data examples illustrate, participants viewed PIPs and the medication reconciliation system as starting points to discuss medications with a patient. However, participants pointed out that PIPs were not a panacea; there were clearly risks that the patient's medication information was not correct or complete. In addition, there was a risk when physicians ordered medications for a patient on a PIP after the admission medication orders were written because subsequent medication orders could be missed. Chevalier et al. (2006) documented similar concerns with medication reconciliation. The medication reconciliation system's effectiveness was largely dependent on health care workers checking, and patients telling about the medications they took prior to entering the hospital. If a patient could not provide accurate information, and if

information on a PIP could not be verified, these gaps in medication information could pose barriers to medication safety for patients.

Briefly, participants in this theme viewed the design of the medication system within their hospital as fundamental to medication safety for patients. While the unit dose medication system was viewed as largely supportive of medication safety, nurse participants identified missing medications as their number one concern and a chronic medication system design safety problem. Medication safety could be compromised if medication security on medication carts or medication drop off boxes was violated. Nurses raised concerns about medication safety when they had to calculate, mix, and administer high alert medications in emergency situations when they were not accustomed to calculating and preparing medication doses on the unit. Participants expressed concerns about the cleanliness and integrity of medication cart work surfaces where medications were prepared and stored. The current pen and paper system of documenting medication administration was seen as antiquated and onerous when nurses documented narcotic administration. However, one nurse participant attributed her hand documentation of a narcotic as the reason she detected an error she made. The provincial electronic medication history supported medication reconciliation by providing a PIP for physicians, nurses, and pharmacists to review medications with patients at times of admission, transfer and discharge, but participants described occasions when these medication histories were a mixed blessing in terms of medication safety. Often, information on a PIP was interpreted differently at different times by a patient in hospital, and tensions

arose when medication orders were changed on a PIP after a patient was admitted, and when medication orders were missed or duplicated on patients' charts.

Unit structures and medication systems surrounded patients and practitioners in this hospital environment, and as participants viewed and discussed these, they agreed that unit structures and medication system design influenced medication safety. Some unit structures and some features of medication systems were seen as tangible supports for medication safety, while others were viewed as barriers or risks to medication safety. Participants were not sure that they could do anything to change semi-permanent structures or the way the medication system was designed. Participants revealed how they coped with complexity and with medication safety barriers they encountered in this environment from unit structures and the medication system by embedding accountability for medication safety into their everyday practice as discussed next.

Theme Three: Embedded Accountability Permeates Everyday Practice

The RNs, LPNs, pharmacists, and pharmacy technicians who participated in this research expressed a strong sense of accountability for medication safety in discussions and actions observed on this unit. Accountability for medication safety permeated and was embedded in their everyday practice. For instance, participants demonstrated their embedded accountability for medication safety as they checked and thought critically about patients' medications. Checking and critical thinking about medications appeared as a fluid process, as participants seemed to be continually checking and questioning if medications were appropriate for patients to uphold medication safety in this system.

Checking and critical thinking. Participants who collaborated in this research brought forth a wide range of examples illustrating how they put their knowledge into practice in a consciously critical, questioning manner to ensure medication safety for patients. Depending on their discipline, nurses, pharmacists, and pharmacy technician participants described varied scenarios of checking medications integrated with critical thinking about medications and patients. Participants revealed they were constantly thinking critically about and drawing on their knowledge of medications, of patients' conditions, and of the hospital environment. Marck (2004) asserts that a restorative approach includes seeking to understand participants' goals in a particular environment or context, and learning from participants about how they achieve their goals when working in health care systems (p.234-235).

Nurse participants conveyed that adhering to familiar fundamentals for safe medication administration practice was essential to achieve their shared goal that each patient received the correct medications for their health needs and to prevent AMEs in hospital. One nurse participant stated in a focus group "we make sure they (patient) are the right person and that the right person gets the right drug by the right route and in the right dose". These fundamental rules for safe medication administration were understood as nurses' disciplinary knowledge, although this nurse participant did not include the right time, reason or documentation as rights applied in practice in this setting.

A pharmacist participant told me her main goal was to review patients' medication orders and ensure that correct medications were ordered for each

patient. She asserted "I scrutinize the entire process from the patient information profile to the meds used to treat the person in hospital to the home meds that are re-ordered to make sure correct meds are ordered for patients" (FG3).

A pharmacy technician participant explained technicians' core work priority was to send correct medications as ordered and entered by a pharmacist to hospital units to ensure medication safety. She told how this usually happened: "once that label comes off the printer, the technician gets that label, looks at it, and goes to pick the appropriate medication in the appropriate numbers, puts the label on it and sends it up to the hospital unit" (FG4). Data examples illustrated how participants applied their discipline- and context- specific knowledge to check medications and thought critically to ensure medication safety for patients.

Registered nurses and licensed practical nurses. Nurses assumed responsibility for medication safety as they assessed patients, planned and provided nursing care based on their assessments, and coordinated in-hospital care for patients. Nurse participants engaged in ongoing cycles of developing knowledge in practice, checking and critical thinking, and applying their disciplinary knowledge to maintain medication safety before, during, and after providing face to face nursing care. One RN participant noted the process to acquire particular knowledge about patients to support medication safety was renewed as each shift began and nurses listened to their colleagues on the preceding shift give report and handover care for patients and their medications. She indicated that she checked some patients' medications or conditions further when she came from report, as information might be unclear:

> *When we come to work we listen to report from the RN on the team going off shift. I look for what medications are ordered for each patient, and think about why the patient takes that medication and if it makes sense why they're [medications] there and what their [patient's] history is. If I find something that seems kind of out of place, I go back and double check that order. (FG1)*

Nurses' actions to ensure medication safety began as they listened to an RN colleague share patient information during shift report (similar to findings by Staggers & Jennings, 2009), thought critically as they moved toward caring for assigned patients, and then checked for the most current information at nursing handovers. Handovers occurred when nurses going off-shift passed responsibility for assigned patients' care to nurses coming on-shift, and answered any care-related questions. Narcotic keys were handed over to oncoming nurses, and nurses ensured that they "know what they need to know" (FG5) as knowledge was exchanged and medication information was validated during handovers at medication carts (Figure 4.15). One nurse participant outlined the importance of meeting with other nurses to exchange information during shift handovers at a medication cart:

> *We come out of report and first we meet the nurses going off shift at the medication cart on our team. RNs on nights will have checked and made a list of what needs to be done or medication re-orders that are needed. We go through the list with the person on the shift just leaving, and they update the list as they update us. So people go to the cart first after report; it's the place where we make sure the people*

coming on know what they need to know with the most up-to-date information. (FG5)

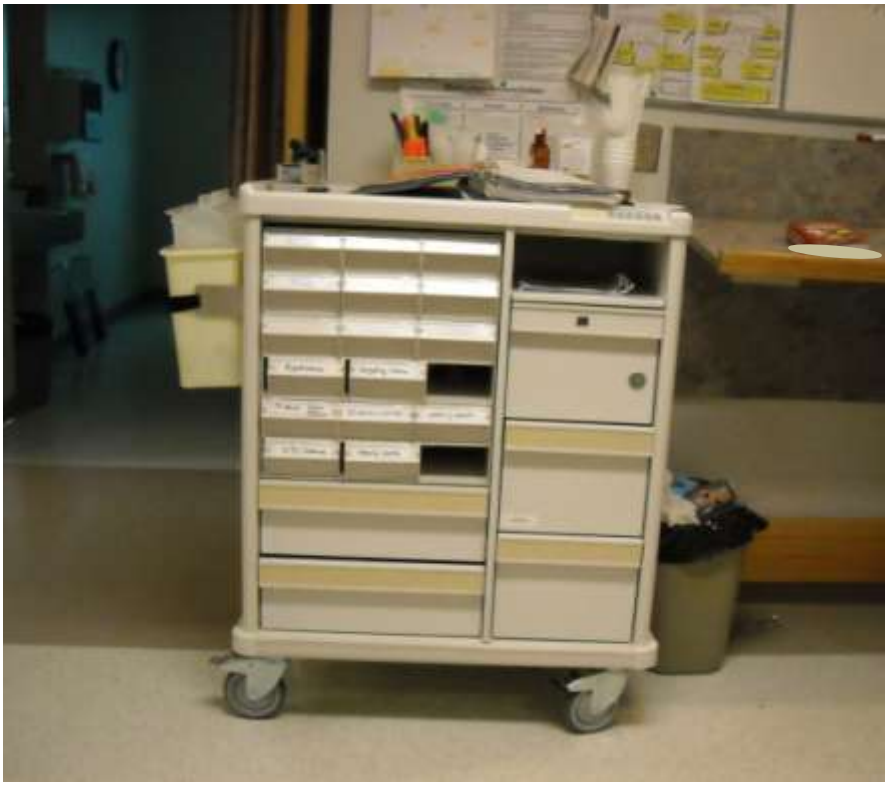


Figure 4.15 Photograph #57 Handovers happen at medication carts PW2

During an observation, an RN participant told of checking medications for her assigned patients with the RN going off shift at a handover. She stated she learned essential information and clarified how she could best support medication safety for patients in her care:

From report I thought this was going to be a horrible day for meds, but it isn't so bad. After report I checked with the RN going off and she had given some of them [morning meds] to our patients. And the patient in room 23 is NPO [nothing by mouth] so I just checked those

orders, sometimes it's written 'NPO except for meds'. He wasn't supposed to get his meds so I just gave his gastric tube a flush. (FO19)

Several nurse participants explained that as they met their patients, patients offered information about medications they were taking, and considered how to best use all information gathered to support medication safety for that patient. Nurses contacted physicians and reviewed PIPs to obtain, clarify, or check that correct medications were ordered for their patients:

We (RNs) often have to phone for telephone orders, or we ask the doctor for medication orders and they give verbal orders, or we look at the Patient Information Profile (PIP) and need to make sure the patient continues on medications they were on before admission. (FG2)

If a medication order isn't legible, lots of times I've had to call the doctor back and clarify the order, or chase them down the hall to ask. I ask the doctor the reason why he orders stuff if I don't know why he's ordering a medication for a patient. (FG1)

We (RNs) clarify medication orders with doctors if it's illegible or ... [pause] inaccurate. And so that's either verbally telling them it doesn't appear to be correct or calling the physician back because it wasn't clear and because we couldn't give this medication the way the order was written. (FG2)

Nurse participants checked print resources before they prepared medication for a patient, which was viewed as supporting medication safety. One nurse participant pointed out "We have a 'how to reconstitute' chart in our MAR binders which we use as a resource when we reconstitute IV meds" (Figure 4.16).

A nurse participant explained nurses checked resources to ensure each patient received "correct medication in the right way" (FG1), which clearly reflects this nurse's goal with medications:

> *We have tables in the back of our MARs and compatibility charts with what is compatible in IV solutions. We check what we need to reconstitute a medication, whether it is saline or sterile water, and what setting (rate on a pump) to run it on to infuse it properly, so a patient receives the correct medication in the right way. (FG1)*

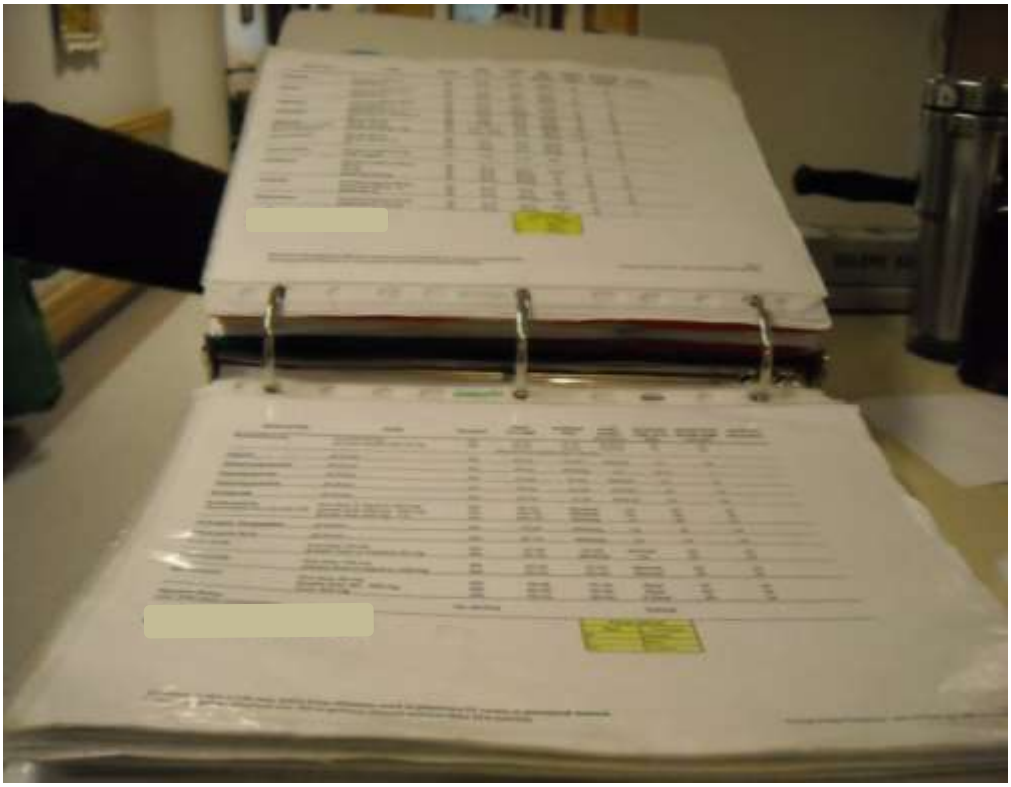


Figure 4.16 Photograph #33 IV reconstitution table in MAR, PW1

Nurses checked if medications prepared for IV administration were compatible with medications currently infusing in the patient's intravenous on a compatibility chart posted on the unit (Figure 4.17). A nurse participant

explained that a printed drug compatibility chart was an important resource nurses used to confirm IV compatibility of medications for patients:

> *This drug compatibility chart on our unit is important because we check the drugs that we are going to give IV to ensure it is compatible with what they already have running. But as you can see, we have to hold the paper back to trace the drug we want to see to find out if it's compatible on this chart. (PW1)*

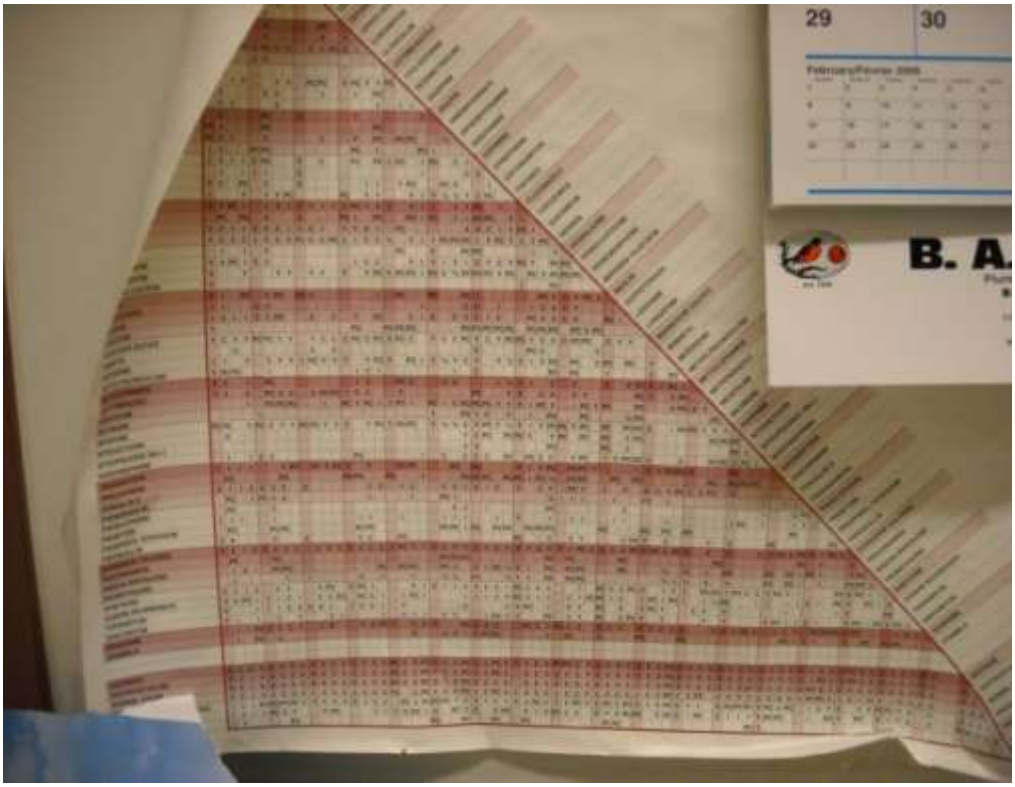


Figure 4.17 Photograph #6 IV compatibility chart, PW1

Another nurse participant described "we go on the intranet to look up medication information" (PW4)

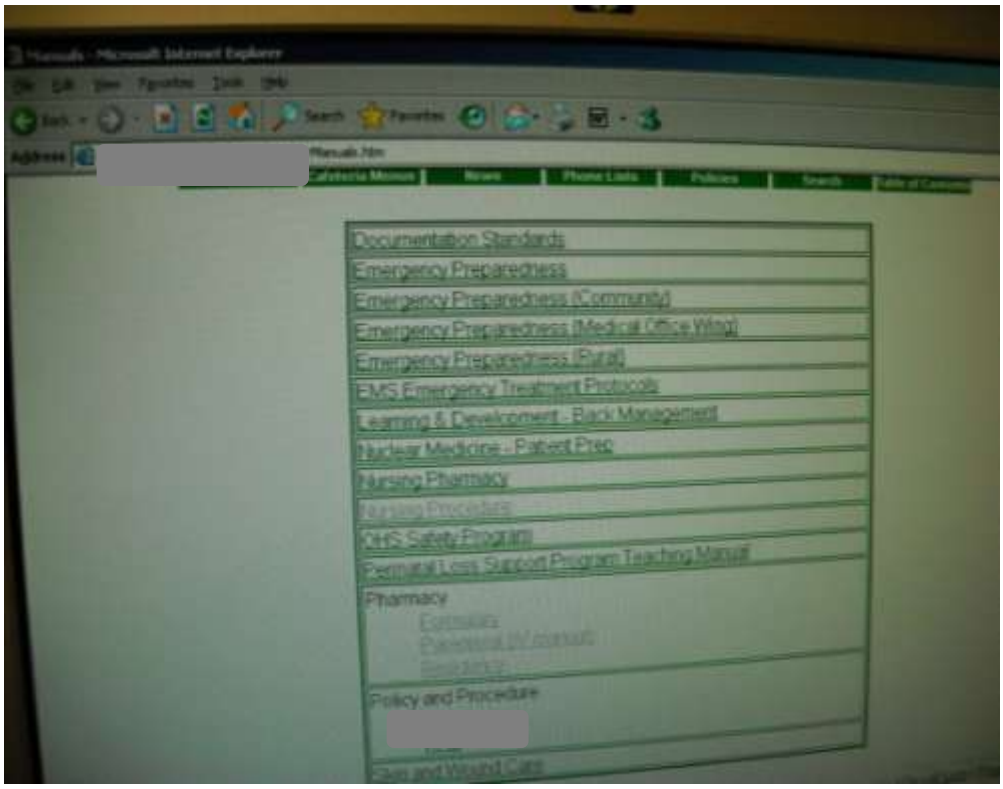


Figure 4.18 Photograph # 92 Computer menu listing resources, PW4

One nurse participant indicated that she checked with another nurse as a knowledgeable colleague and resource when she prepared medications in emergency situations: "it can be hard to figure out how to mix up an IV med in an emergency situation, so I get someone, a second nurse, to look over what I've mixed to just check before I administer it" (FG1). Consulting or checking with a patient, nurse, physician or a pharmacist about medications was an action nurses embedded in practice to support medication safety as this participant described:

> *You're checking and you're asking, 'how come you (patient) are ordered 4 anti-hypertensives?' And sometimes the patient can't tell you, so you talk to your co-workers and go, does this look right, the patient has a BP of this, and is on 4 anti-hypertensives. Or you can call the doctor, put it on the ask list, or ask our pharmacist to look at*

it. Our pharmacist happens to be phenomenal. I find her if she's on, and ask her about drugs or multiple drugs together, dosages, effects, times, or like that. (FG2)

Several other nurse participants spoke of using nursing knowledge to check, and think critically when administering medications to patients, similar to Cheek's (1997) findings, this demonstrated medication safety was an ever-present concern for nurses:

Ok, you look at your MAR and read that medication is scheduled to be given. You open up your patient's drawer or cassette on the medication cart, double check the oral medication that you are supposed to give at this time with the patient's name, to the package with the pill in it, to the dosage of the medication to make sure it is correct, and the route, comparing this to the MAR and the package. Then you open the package and pour this in the patient's medication cup. You check meds one at a time, and put them all in a med cup. Then you go to the patient, double check their arm band with the MAR paper to make sure they are the right person, and you have the right drugs for that person, right route, and right dose. (FG1)

This nurse participant expressed her responsibility for medication safety for all meds for each patient:

With other than oral meds, you still do all the same checks, and it's not just mechanical, because all the time you're thinking, 'is this the right drug for this patient at this time?' not just 'is this the right drug as ordered?' I have to know it is the right drug for the patient, because I am responsible if I give it. Then, I usually try and say to the patient 'Hi Mr. ___, this is what these medications are that you are

getting, this is your ___ and your ___, do you know about these medications? (FG1).

One nurse participant stated she questioned what would be optimal for each patient to support medication safety: "You have to really think about what the med is, and when the patient is supposed to take it and figure out what that means for the patient in terms of nursing care" (FG2). Nurse participants routinely considered what cues a patient gave, and if cues suggested a patient's medication administration should be adjusted, similar to Eisenhauer et al.'s (2007) findings, as they exchanged knowledge with each other:

I know I use judgment to think ok, well these pills are ordered for 11 o'clock at night, but because the patient has had a bath and is just starting to settle down, I'm not going to wake her up in an hour to take pills. I'm going to give them a little bit earlier. So you use your judgment thinking about the kind of medication it is, how the patient is doing, and what the patient's preference, schedule, or condition is. (FG1)

We have patients who have had strokes or brain injuries on our unit. You need to check whether the patient is able to swallow medications if you crush them and put them with applesauce or thickened fluid. You look at what the patient can safely swallow or tolerate; and what their preference is. (FG1)

With a narcotic, we assess the patient's pain, as we talk to the patient to find out where the pain is and how bad it is. Then we check the MAR; decide what the appropriate drug and dose is, if there is a range, and if they can have analgesic now according to the order and times that it can be given. We check to see if they have ever had analgesic before, and if so, was it effective, we ask the patient or look in the charts; sometimes we know this from shift report. (FG1)

A nurse participant asserted that being able to prepare and administer patients' medications from a cart in the hallway supported medication safety. This nurse valued the times when she focused on and assessed patients using her senses (e.g. vision, hearing, smell), and patients could see her preparing their medications at the same time, as she checked the appropriateness and timing of medications ordered for that patient from a medication cart adjacent to a patient's room:

> *We move the medication cart up to patient's rooms and then prepare the medications on the top of the cart within the patient's sight. We can see and talk to them (patients), and they can see us preparing their medications, we assess patients continuously as we prepare and give them their meds. (PW1)*

Figure 4.19 Photograph # 50 Medication cart outside patient room, PW1

Nurse participants checked patients' signs and symptoms after administering medication. They looked for expected medication effects and AMEs for patients:

> *And you would want to know the patient' vital signs, and if there is blood work needed, like a CBC or Renal panel or something to secure the range and evaluate what you have given against the patient's response. If you gave a diuretic because they are really wet sounding [in their lungs], and you're worried about it, you watch urine output and how they are breathing. (FG1)*

> *I look at Dilantin [blood] levels to see if this patient's result is in therapeutic range. If they are not absorbing this medication even though we gave it, they could have seizures. We are responsible to not only give the medication but to check if the patient benefits from it. (FO19)*

Another strategy used by nurse participants was checking of patients' charts for safe medication administration, to evaluate medications' effects and detect AMEs. Nurses reviewed patients' charts to identify medication problems and take action to correct problems if detected. Nurse participants described they thought about what each patient needed for optimal care to heal and restore their health, as they checked charts. One RN described "when we are checking charts we are thinking about what we know about that patient and what we [nurses] can do to make it better for the patient to improve their condition now and on discharge" (FO21). Nurse participants talked about how they reviewed patients' charts:

> *On nights we check every patient's chart. We check all the orders and we review all of the patient's medications. Usually I check each medication and see if the patient still needs it, for like an antibiotic*

that's ordered, I check if I don't know why it is being ordered and if it's still needed. If I can't find the answer to a question about a certain medication, I put it on the ask list and have the morning staff ask the doctor if that medication is still needed, or should the dose be reviewed. (FG1)

I check what tests were done, if the results of the tests are back and what they are. I check that all the medications were accurately recorded, and then draw a line in the doctors' orders that the chart has been checked [on nights]. I check the medications on the next day's MAR against the meds from the first orders, file yesterday's MAR, and check the nursing care plan to see that it is kept up to date. When checking charts at night, we must be especially alert for medication inconsistencies; this is when a lot of med errors are found. If an error is detected, I make out an occurrence report, not just send a medication note to pharmacy. (FO19)

Nurse participants identified one area of their practice where potential medication safety risks existed for patients, as nurses did not routinely write a list of medications that physicians ordered for a patient to take after discharge from hospital. Nurses envisaged a time when they could print a patient's discharge medication list with instructions for use of prescribed medication after discharge, and they would give this individualized list to each patient prior to discharge to support medication safety after hospital. Several authors suggested printed patient medication lists given to patients at discharge would support patient safety after hospital care (see Manning et al., 2007; Unroe et al., 2010). However, as one nurse participant described:

Well, when I'm thinking about the patient's discharge medications, I don't ever hand write what drugs they [patient] are taking on a discharge care plan, because somebody told me that if you write it and its wrong then you're in trouble and you're responsible for giving the wrong information. And sometimes different doctors have ordered different drugs. (FG2)

I do go through the list [verbally] of what they're on now and what they were on at home and compare them and remind them [patient] to tell their doctor that 'I need a prescription for this' to catch them up to what they are on now, but I don't write them [medications], I don't do medication counselling for them unless it's Warfarin [anticoagulant medication] teaching, but I do tell them about their medications, just telling them, not writing it down for them. I tell them any new drugs will be written on a prescription by the doctor. So what is happening is that I'm using nursing knowledge of this patient and what they might have said to us, what they would not maybe say to the doctor, to have a conversation in order to try and make sure that they're set up safely to go home. (FG2)

The nurse manager asserted she did not set the nurses' processes, rather nurses established their medication procedures as they worked with patients on this unit and followed standards of practice and principles they learned and continue to learn as they provided nursing care. Nurses remained vigilant as they watched for potential medication risks and reported medication occurrences; this view of nurses' work with patients' medications was reported by other researchers (see Dilles et al., 2010) and espoused by this nurse manager as she stated:

I don't see that I influence the nurses' process with medications as a decision maker that sets their process. The nurses administer medications, and the process they use is learned from when they are educated and they modify their process to fit with the patients they are

assigned to, in each work setting. I would say the nurses set the processes they use based on their knowledge, like the night nurses check medications on each patient's chart. (FG3)

As nurse participants discussed their work, they revealed their embedded accountability to check and think critically about every medication for every patient, and drew on nursing knowledge to support medication safety by ensuring patients received appropriate medications while in hospital. Nurses spoke of trying to ensure, through conversations with patients and other practitioners, that patients would have correct medications in hospital and upon discharge. Much of nurses' embedded accountability for medication safety was conveyed by their actions and communication about medications with patients and other health care practitioners. Pharmacists' actions which illustrated checking and critical thinking as accountability are presented next.

Pharmacists. Pharmacist participants discussed actions taken that revealed their practice accountability for medication safety. Each day, a pharmacist was assigned from the central pharmacy to cover this unit to screen medication orders for patients. Clinical pharmacists assessed and critically thought about patients' medications obtained from patients' medication histories and medication orders from charts, and entered orders into a pharmacy system computer program. Pharmacist participants described their processes on this unit that supported medication safety for patients were related to medication system design, which included this cart based unit dose system and medication histories obtained from patient information profiles:

With a dedicated pharmacist for a unit or a service we develop concise knowledge of one area and are able to recognize patients and track changes. When we work in one area we can see red flags and can address them as soon as they are detected. (FG3)

I watch that doctors don't order the same drug but in a different name like a generic and trade name drug so the person does not get twice the dose. I enter medications ordered into the pharmacy computer system, so that they will print on the MAR. I think medication safety is a key to patient safety in hospitals and safety when the people go home. (FO14)

A pharmacist participant shared this story of how she intervened to correct discharge medication orders for a patient. She assumed accountability to attain a discharge prescription for appropriate IV antibiotics for this patient based on her medication assessment and knowledge:

This morning I was sitting at the [main] desk, and I saw a Home IV form that was filled out for one of the out-of-province patients. The medication on it was not ordered to the correct interval, but it was ready to be faxed to the home hospital pharmacy as the patient was being discharged today. I was able to go see the patient, phone the physician and say 'look these are your options for what you want to do', and he actually re-wrote the entire order. The patient is on totally different medications than were originally ordered, and it was just by chance that I was there and I checked, because that order was not double sided and pharmacy here may not have gotten a copy of the order. The order was going to a rural pharmacy, and the mistake may not have been picked up there. (FG7)

These exemplars illustrated pharmacists' checking and critical thinking about patients' medications as actions which supported medication safety.

Pharmacists were accountable as they ensured that medications were ordered correctly for patients through processes embedded in their practice. Pharmacists also collaborated with other practitioners to ensure patients had appropriate medication regimes ordered, as reported by other researchers (see Holden, Watts, & Walker, 2010). Pharmacy technician participants told of their medication safety practice activities next.

Pharmacy technicians. A pharmacy technician participant mentioned that technicians routinely checked medication resources before medications were prepared, emphasizing that strict guidelines for medication preparation were followed to support medication safety: "to prepare a medication, for instance an IV medication, we basically don't do anything without a reference of some sort, and we check the reference before we start a procedure" (FG4). Another pharmacy technician participant asserted that pharmacy technicians check when preparing any medications for patient use "we have guidelines that tell a person everything that they need to know to make that particular drug, like we have worksheets available that tell us exactly how to make it, how much diluent to use" (FG4).

Pharmacy technicians prepared many medications in a sequestered preparation room inside the pharmacy (Figure 4.20). Technician participants described their stringent processes to prepare sterile and stable IV medications, similar to processes described by Saginur et al. (2008):

> *We have to scrub, gown, glove, and mask before we can work in this room preparing IV meds for the hospital. You can see the inside room through the doorway where we prepare and make antibiotics in*

batches of 'usual' doses with strict guidelines for sterility and stability and freeze some for later. Many IV medications can be prepared and frozen without changing the chemical composition of the drug. (PW3)

Figure 4.20 Photograph # 87 Pharmacy IV medication preparation room, PW 3

Participating pharmacy technicians contributed to build a story to illustrate how their processes to put medications as ordered into patients' cassettes and distribute these to hospital units during pharmacy hours support medication safety for patients:

We take the label off the printer and look for the drug, either IV or other medication. We have stock IV meds in the fridge and freezer, if an IV antibiotic is needed, it may be in stock, because we make batches to have stock of common doses. (FG4)

The pharmacy dispenses unit dose medications that are pre-packaged in an ATC (automated tablet compounder), as a strip of packaged and labeled meds for each patient. These are put in the drawers or cassettes with any other meds needed, and taken to the nursing unit once a day by pharmacy technicians, as we exchange filled cassettes for the previous day's cassettes on each medication cart. Otherwise, porters bring medications to the units when there is a call for stat or missing medications, or the in- between missed meds. (FG4)

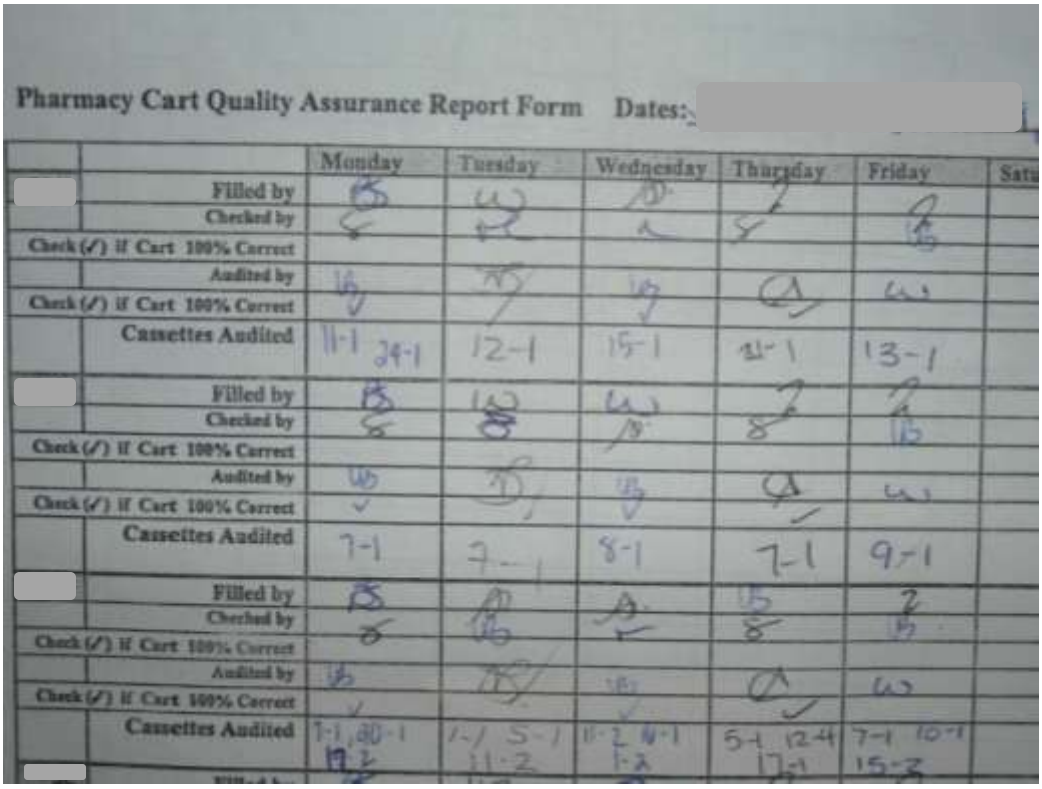
We do an IV exchange when we do a cart exchange at 3 PM each day, that's about the only time techs ever take meds to the unit, other than narcotics. Narcotics are delivered once every day, and narcotics are solely handled by pharmacy staff. (FG4)

Pharmacy technicians monitored and counted medications left in patients' medication cassettes retrieved during cart exchanges and questioned why medications were left over, and what this meant (such as was a patient discharged from that unit, or did that patient not get that medication?). A pharmacist noted that pharmacy technicians charged medications taken from patients' cassettes to units, and medications left in cassettes were reported to a pharmacist:

When the cassettes come back to pharmacy, we actually count meds left in them; we use that as part of the charging system, so we know if we sent up 8 and 6 come back, they have used two. And when cassettes with pre packed meds come back downstairs, the technicians think maybe somebody had two tablets as a dose to take, but they only got one. If that happens more than two or three times in a row, then the technicians notify the pharmacist and say 'I don't think your patient is getting what they are supposed to, go take a look at this'. (FG7)

Pharmacy technicians discussed their actions to check their work and record ongoing audits (Figure 4.21), to ensure that correct medications as ordered were placed in patient cassettes before cassettes left the pharmacy for distribution to hospital units. These self-check procedures support medication safety. One pharmacy technician participant described "tech check tech" (Van, 2007, para 1) procedures demonstrated to monitor the accuracy of their work through in-pharmacy checking of patients' medications in cassettes:

> *We have tech check tech procedures to check that we are filling the medications as ordered in patient cassettes. We check and audit meds we put into the cassettes as part of our process and record our checks each day on this form posted in our department. (PW3)*



Pharmacy Cart Quality Assurance Report Form Dates:

	Monday	Tuesday	Wednesday	Thursday	Friday	Sat
Filled by						
Checked by						
Check (✓) if Cart 100% Correct						
Audited by						
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Cassettes Audited	7-1	7-1	8-1	7-1	9-1	
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Check (✓) if Cart 100% Correct						
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Cassettes Audited	7-1, 80-1	1-1 5-1	11-2 8-1	5-1 12-4	7-1 10-1	
Filled by						

Figure 4.21 Photograph # 8 Pharmacy tech check tech report form, PW3

A pharmacy technician participant explained that historically pharmacy technicians delivered most medications to nursing units; although now they deliver once daily due to changes to their duties in pharmacy. Delivering medications to hospital units was a task that a pharmacy technician participant described as "portering" (FG6) and not generally a pharmacy technicians' job responsibility at this time:

> *I remember when pharmacy technicians would bring a medication to the unit, before our role evolved. We are actually doing all the checking now and actually running the dispensary. We were used as portering systems and we would drop off medications. Things have changed and we don't do that anymore, we don't have the staff to deliver every medication. (FG6)*

These examples represent what pharmacy technician participants expressed as their accountability for medication safety exercised in their processes and practices of medication preparation, selection, and distribution. Pharmacy technician participants described that they checked to monitor and charge for medications sent to hospital units, and checked and audited each others' practices to ensure correct medications as ordered were placed in cassettes.

In summary, examples of embedded accountability illustrate how practitioners checked and worked to support medication safety in hospital. Nurse participants checked and thought critically as they engaged in handovers, patient and medication assessments, medication administration practices, real time chart reviews, and knowledge exchange about medication to support medication safety. Pharmacists checked and assessed medication orders for patients, entered orders

into a pharmacy computer system, and communicated medication information to other health care practitioners. Pharmacy technicians described stringent procedures to prepare and check medications ordered and dispatched to hospital units. Concurrently, participants recognized that they exercised their professional accountability within the context of unit structures that they viewed as more or less supportive to their efforts in a complex medication system (similarly described by Ebright, 2010; Marck et al., 2006a), and unit culture. Aspects of unit culture associated with medication safety are explored in the next theme.

Theme Four: Culture Makes a Difference to Medication Safety

The importance of unit culture to medication safety emerged as it became apparent how culture, as shared beliefs and values, was woven through the ways that participants discussed and practiced together on this unit. In this context unit culture was visible in ways people communicated about medications, what people valued and how they treated each other and the place they shared as they worked together. It was clear that nurse participants valued learning as they accessed resources and shared what they learned to improve patient care and medication outcomes on their work unit in this complex hospital system. Participants discussed and demonstrated their respect for this unit's history as it affected medication safety, and there were numerous instances where team members described their appreciation for working together and using communication patterns that strengthened medication safety. With a restorative theoretical perspective, culture is viewed as a reflection of how community members do or do not respect the history, culture, knowledge, and rituals that strengthen and

sustain their shared place (Marck et al., 2006a; Higgs, 2005; 2003). Unit culture can be a support or a barrier to medication safety. The nature of unit culture was most apparent as participants discussed their perceptions of learning and growth, communication, teamwork, and their capacity to make system changes.

Adaptive Learning and Growth

Pepler et al. (2005) argued that unit culture for nurses was linked to patterns of research utilization and included "harmony of research perspective, motivation to learn, goal orientation, creativity, critical inquiry, mutual respect, and maximization of resources" (p. 67). Nurse participants engaged in this study early, which indicated that members of this practice community shared an interest in learning about medication safety and research participation. During my early observations in March 2009, I noticed nurse participants visibly sought to learn new skills to support patient safety on this unit with ceiling track devices installed to support patient lifts and transfers in every patient room. Unit nurses were visibly engaged in learning about safe patient transfers, lifts, and repositioning with these new patient care lift devices.

Posters and resources to support practitioners' learning about medications were displayed on walls (see Figure 4.21) and interior doors of the unit (see Figure 4.22). For instance, resources included lists of acceptable medication abbreviations, and drug compatibility charts. In a focus group, the nurse manager spoke of maintaining up-to-date medication resources indicating that she supported a learning culture by ensuring resources were available for nurses to engage in learning and could adapt their practices accordingly:

There are many resources on the unit to provide reading material or resources to look up a medication. I can influence resources; for example I just ordered a new CPS (drug information book) for each team. And I get the most recent drug compatibility charts when these are available from pharmacy. I want the most up-to-date ones with all the new drugs that have been released. We also have several accessible computers here to look up resources on the intranet. (FG3)

Nurse participants were seen accessing resources on unit computers to find answers to questions about medications for patients with complex conditions. During one observation, two RNs invited me to listen as they discussed medication treatment ordered for a patient with an unusual syndrome. One RN had located and was sharing information with colleagues about the correct way to administer the prescribed antidote for the syndrome by slow IV electrolyte infusion (FO11). Being included in this informal knowledge exchange between two staff nurses illustrated that this unit's culture not only supported learning and adapting practice, but practice community members sought and shared knowledge. An RN participant in a photo walkabout drew attention to a medication chart posted high on a wall that was meant to support everyday nursing practice with patients who have diabetes:

This (Figure 4.22) is a chart of oral medications for diabetes management produced by our own RQHR diabetes unit. The chart shows different drug types, as well as onset of actions, and side effects and interactions. We use this chart quite frequently, the only drawback with this one is it is positioned quite high on the wall at the main desk

area, so I think some people are not aware that it is here and it is not too visible, but it is actually a good resource for nursing use. (PW1)

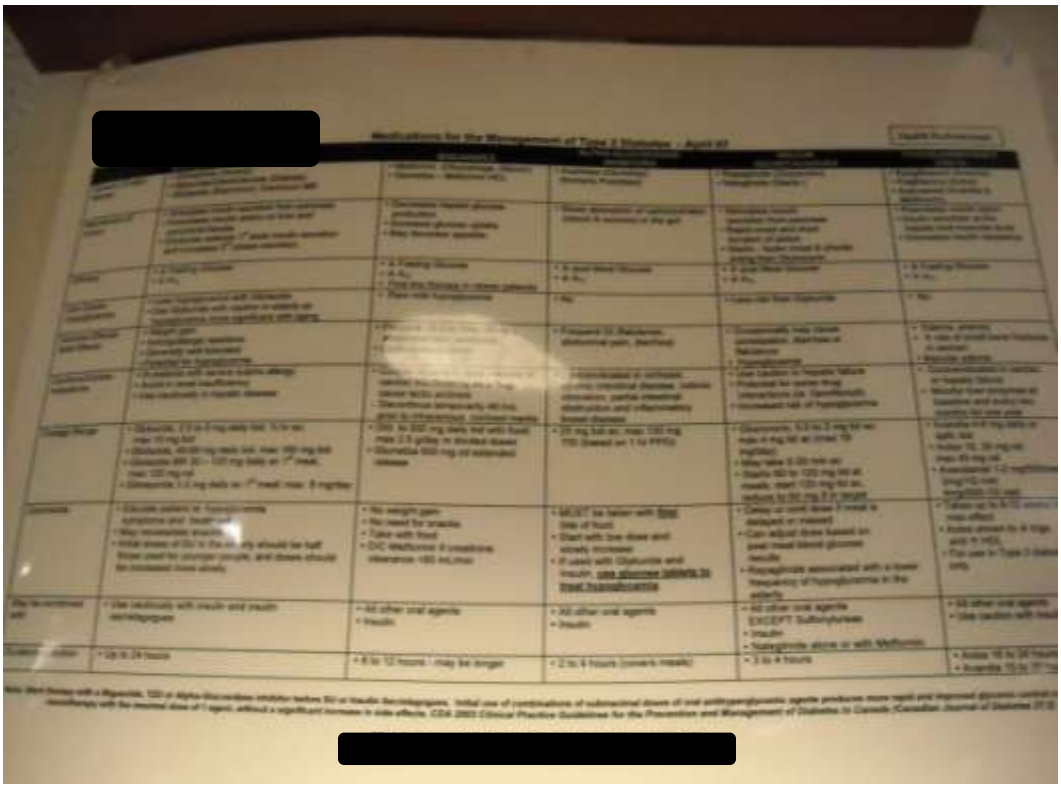

Figure 4.22 Photograph # 5 Chart with diabetes medications, PW1

Medication posters displayed medication and patient care information; one nurse participant requested a photograph of the medication room door (see Figure 4.23) where information posters were placed. Information posters were viewed as a socio-technical approach to educate nurses when the information was about avoiding medication errors. Nurse participants discussed that they frequently referred to charts and posters as quick reference guides and specific medication information that they looked up to adapt and support safe practice.

Figure 4.23 Photograph # 9 Information posters on medication room door, PW1

One RN educator described this as a "good unit" with well educated nurses, who were knowledgeable and worked in a "primary nursing model" (FO2):

> *This is a good unit. RNs here work in a primary nursing model, and really know what is going on with their patients. On this unit, nurses are well educated. If you talk to them about a medication related treatment, they know what you are talking about and if it is ordered for a patient, it'll happen, because the nurses really work with these patients. (FO2)*

This nurse educator stated she viewed the way nurses practiced on this unit as a primary nursing model; however, none of the nurse participants identified that they practiced in a primary nursing model, rather that they relied on resources

and other team members to support safe nursing practice in this unit culture. Learning and sharing knowledge seemed to be a deeply-entrenched way of being on this unit as nurses sought knowledge, adapted practice, and assumed responsibility to help patients with their medications as part of their learning and adaptive practice in this unit culture. Members of this nursing practice community learned about medications from experienced staff on the unit and adapted their practice to nurse individual patients "rather than just trying to get through all these medications" (FG3) as the nurse manager highlighted:

> *Other resources are experienced staff on this unit; we have some very senior staff. Consistency is a great breeder for experience. For instance, nurses with ten years experience don't have to look up so many medications, like ones to deal with patients' high blood sugars, patients' blood pressure meds, the side effects and subsets of drugs. Patients are seen as individuals with different mixtures of drugs and we can focus on individual outcomes rather than just trying to get through all these medications the patient has ordered. Experienced nurses help others with this. (FG3)*

Nurse participants described how they administered some medications based on identified best practices, which were assimilated as unit specific standards for IV medication infusion, for instance Heparin IV was routinely infused on the primary line of an IV pump. Unit collaboration to develop unit standards indicated nurses learned and adapted their unit wide practices as a component of unit culture. One nurse participant described the heparin standard:

In the picture, um, photograph (Figure 4.24), IV heparin is infusing with a pump, so as per our standard of care, heparin is always on the primary, so that we don't get confused about primary-secondary rates and accidentally infuse heparin at a faster rate than it should be given. As part of our medication safety we have a heparin protocol, and we are the ones responsible to titrate the amount of heparin a patient gets according to heparin protocol. (PW1)

Figure 4.24 Photograph #53 Intravenous Heparin on infusion pump, PW1

Nurse participants reported that they accessed resources from outside their unit, and participated in initiatives to support medication safety, once again reflecting a unit culture where nurses seek to learn and adapt to changing practices. Three RN participants exchanged knowledge with colleagues in a focus group discussion about previous adaptations to on-unit medication storage (what,

how, and why it was changed), and upcoming changes that could require changes to medication practice:

> *One of the things we did on this unit, a few years ago was separate our 500 ml. bags of IV Heparin and Mannitol that have the same red lettering. We had kept them side by side in the same cupboard, and there were a couple of times where somebody grabbed the wrong IV medication and hung it for a patient. So we adapted; we separated where we store these IV solutions, so we can go to that cupboard to get it and we don't make a mistake. (FG2)*

> *For medication safety, pharmacy is changing labeling of drugs dispensed to units for drugs that have similar sounding names. The labels will highlight the differences with tall man lettering or pharmacy will use the name Dilaudid instead of hydromorphone. There is potential for error at present with drugs with similar sounding names, and different labeling could reduce the risk of error. And then, we have been working to reduce the number of accepted abbreviations because of potential for confusion interpreting handwriting on orders, and we have narcotic awareness posters about narcotics with similar names. (FG2)*

> *Some of that medication safety culture is driven by national and international safety strategies that are adapted to practice. So the use of tall letters for labeling medications will be used in a new format of MAR that is being developed and the IV parenteral manual. Even drug companies are being encouraged to look at their labeling and packaging of drugs to highlight the different drug names. (FG2)*

These examples offered a glimpse of nurses' engagement in adaptive learning and growth on this unit as they sought information, shared stories and discussed medications and health conditions of patients to increase their

knowledge and improve their future practices. Nurses within and outside this unit were aware nurse members of this practice community actively sought knowledge to adapt and improve their patient care. Visible signs that nurses accessed and used medication and other resources were the posters on interior unit walls, experienced nurses sharing their knowledge with other nurses, and the nurse manager's observation that experienced nurses supported other nurses to make sense of patients' medications and improve patient outcomes. This learning and adaptive growth, as one indicator of unit culture, was supported by unit communication patterns and practices, which are discussed next.

Communication. Communication patterns and practices used to support medication safety included nurses clarifying medications with patients (when reconciling and discussing medications), physicians, and pharmacists. In addition nurses checked patients' charts and made notes to communicate and remind other nurses to check certain details about patients' conditions and their medications, and to verify and clarify medication orders. Communications between nurses and pharmacists often centered on medications ordered for patients, and this generally supported medication safety by knowledge sharing as Holden et al. (2010) noted. Pharmacy technicians communicated with other pharmacy technicians and pharmacists. However, pharmacy technicians and nurses working on units did not visibly communicate with each other about medications, and nurses mostly left telephone messages about missing medications for pharmacy technicians. Communication about medications between people on the unit shaped medication safety.

Nurses on this unit expressed that they communicated with patients frequently to learn about what medications patients were taking, how they were taking them before coming to hospital, and what their responses were to medications taken in hospital. Nurse participants stated they enjoyed talking to and listening to what a patient said about their medications (FG2,); this knowledge exchange symbolized a facet of unit culture where nurses engaged with patients to improve medication safety at the time and in the future:

> *One more thing, I like talking to the patient themselves about their meds. Many times they know, like some patients don't know, but some patients do know about their meds. We talk and interact with the patient, you know they say well you know this really bothers me could we get something different for them and we listen to what they have to say and sometimes we ask the doctor. (FG2)*

> *We often have to explain to patients that pharmacy sets the times that medications are scheduled for, and we usually give them [meds] at the times pharmacy set. I'll listen to and explain myself over and over to a patient, but sometimes families make you feel like they are trying to catch you doing something wrong. Other families aren't like that, they're just trying to help their family member that isn't doing so good. (FG2)*

One nurse participant discussed filling out a form to request that a pharmacist change times scheduled on a MAR for a patient to receive antihypertensive medications. Pharmacists could with a few key strokes alter scheduled medication times that printed in a patients' MAR. This nurse spoke of

communicating with the pharmacist when a patient told her he normally took his blood pressure pills at a different time at home:

> *With a lot of the daily antihypertensive meds pharmacy will automatically schedule them for 10 o'clock in the morning on the MAR, and some people take Norvasc at bedtime. If that's what a patient tells you that they do at home, then I would just schedule it differently and then fill out a pharmacy communication form, and the pharmacist will maybe change the times on the MAR for that patient. Many nurses here do what they can to advocate for their patients. (FG1)*

Nurses communicated with other nurses on upcoming shifts on MARs, for instance, nurses who checked charts at night wrote notes on MARs to remind oncoming nurses to check and record a patient's pulse or blood pressure beside a scheduled medication. A nurse participant described this communication supported medication safety as one way to "look after the patients and each other" (FG2), which meant nurses contributed to cultural integrity on this unit:

> *At nights when we are doing our charts, when I am checking my MAR for the next day, I'll put in little notes on the MAR right beside that med time. I might put pulse, or BP, or whatever and then a blank, just indicating for that day nurse this is something we want to keep an eye on before we give this dose. So this is a form of reminding the next person or communicating what to check for. We try to look after the patients and each other, you know. (FG2)*

During field observations, nurse participants were frequently seen checking all of the patients' charts. I interpreted this observation to mean that nurses

created a safety net of checking patients' medications and responses to medications, not just checking for errors, and this became an expected action that was valued in this unit's culture. One nurse participant explained:

> *We (RNs) really rely on whoever checks charts on nights, and on our pharmacist to see that medications are not ordered that "fight each other", and that medications that should be ordered are ordered. (FO19)*

Several nurse participants stated "we check all the time" (FO3). This statement revealed that nurses shared an expectation that nurses on this unit constantly checked medications, their practice, patients' responses to medications, and availability of medications from pharmacy to support medication safety:

> *You have to be conscious that as a nurse, we check, check, check all the time with medications. We are checking for IV administration or, not just the way to administer it, but drugs' effects, like is it the right drug for my patient? So we maybe check signs and symptoms of any overdose or adverse effects, compatibility, what should we be monitoring with this medication, like their blood pressure, time to action, reason for this drug, and ...if the drug has come up from pharmacy yet. (FO2)*

Given a unit expectation that other nurses, often those working night shifts were constantly checking and writing notes to alert other nurses about medication discrepancies, one nurse participant shared her consternation during an on-unit observation, when she discovered a potential medication error that she could have made which would have resulted in unnecessary pain for a patient. In this

negative or variant case situation (Morse & Richards, 2002, p. 159) a nurse described that a patient told her he was missing medications; the nurse characterized this situation as a failure to communicate that was unexpected considering the unit culture to check each patient's medications on nights. This oversight could have resulted in an AME for this patient, as medications that should have been printed as scheduled on his MAR were missing:

> *A patient told me "I didn't get my 8 o'clock Hydromorphone, and Gabapentin." I checked the patient's PIP and these meds were there but not on today's MAR. This patient got these meds on his first day [in hospital], but they [meds] were not on the MAR today. Luckily he was a reliable historian and told me he missed them, otherwise I would not have noticed, because it is my first day back [after days off], and nothing was said about these meds in report. Missing these meds could have really affected him; he could have gone into withdrawal as he has been on them for a long time. He did receive the meds, because I faxed the PIP and transcribed meds to today's MAR, and gave them. In this case I think the doctor ordered the meds, but somehow this order wasn't entered on today's MAR. Our RN on nights usually goes through MARs back to admission, and 'figures out' the meds, so I don't know how the order was missed, maybe it wasn't entered. (FO4)*

This nurse assessed this communication failure as a risk to medication safety and she immediately questioned the lack of communication from night nurses to alert her to this situation, and then questioned if the order had not been entered by a pharmacist. This negative case revealed that nurses depended on each other as their first line of support to check patients' medications as a component of unit culture.

Most communication patterns witnessed on this unit supported medication safety for patients and illustrated a patient-focused unit culture. During one of my observations, an RN who specialized in diabetes education for patients remarked about channels of communication that reflected the unit culture here, where she could speak to any nurse and this would ensure that medication information would be followed up appropriately:

> *Communication here is well done; you talk to a nurse and it gets done. Pharmacy here is good, well when their usual pharmacist is working. On some units you have to know who to talk to, because people change and information may not be passed from shift to shift. If ever things happen on this unit, you just have to talk to a nurse on the unit and it will be corrected. (FO2)*

Pharmacy technicians, on the other hand, were seldom seen on this nursing unit. A pharmacy technician participant indicated it was difficult to communicate salient medication information to nurses on a hospital unit:

> *It's hard to get medication information to who needs to know it, it is almost impossible. It takes a long time to filter through to everybody who needs to know, you have got nurses and pharmacy staff who work twelve hour shifts, and nurses and pharmacy staff who work eight hour shifts, and there are just a lot of people. You can send memos and you can send emails, and people if they don't have access to a computer, you know personal access to a computer, and they don't read their emails all that often. It's tough. (FG6)*

This lack of communication could pose a potential risk to medication safety if medication information was embargoed, for instance this pharmacy technician

participant remarked that information about storage requirements for particular medications was not communicated:

> *That's another thing [that is not communicated], on the nursing units they have a lot of things in the fridge that don't need to be kept in the fridge, like all the heparin syringes that come pre-packaged from the company; and the unopened vials of heparin can just sit in the cupboard until they are opened, then they have to go in the fridge. (FG6)*

A pharmacy technician participant in a focus group shared her frustrations with how she viewed communicating with people on nursing units, and how pharmacy technicians typically responded, or did not respond, to nurses phoning for medications:

> *We often get calls for meds from nurses on units to pharmacy. A nurse will say, it's me, I've got this, I need this. And they want us to, you know, understand what they are talking about. But we can't send any medication for a patient to a unit unless it has been entered by a pharmacist, or it is on their ward stock list. And then when we are called, we have to send it if it is ordered, even when we have had three calls from the same unit and sent the same med already twice before, because no-one has looked in the pharmacy bin. Sometimes nurses don't seem to know that that medication was sent. If we had a better way to communicate with nurses on the floors, it could save us some of these phone calls, and you know it might keep them from phoning us again and again for the same meds. But we don't really talk to the nurses about this, we just send the med and we send it again, and send it again when they phone. (FG6)*

This pharmacy technician's statement "we don't really talk to the nurses" suggested that she did not feel empowered or inclined to discuss medications with nurses in this system. Rather, she and other pharmacy technicians just continued to send medications up to hospital units if medications were entered and requested during their work day. Pharmacy technicians seemed to expect to engage in very little two-way communication with nurses in this system, and did not often initiate communication about medications. Nurse participants on the other hand indicated that they phoned and left messages on the pharmacy department answering machine, to request pharmacy technicians send medications for patients.

Unit culture was reflected by communication patterns about medication errors. Participants quoted earlier in this chapter indicated nursing staff shared information about medication errors in an effort to help each other learn from mistakes, for instance, the nurse that said she made an error when all the meds in the cart drawers were mixed together (FG5). This practice could be related to a health region medication error policy which encouraged employees to view errors as a means to continuously improve processes. This approach to medication errors logically supported medication safety, and alerted nurses to scrutinize their medication processes for improvement opportunities. Nurse participants discussed with me and their co-workers how medication errors were viewed and approached, why they thought medication errors occurred, and what could be improved. For instance, one nurse participant described that medication errors occurred and "you can't focus on blaming when things happen, you have to find out where the slip was and try to make sure that slip does not happen again"

(FO1), which indicated that nurses on this unit wanted to learn from their own and others' mistakes to prevent these in the future. Nurse participants described times when they would report a medication error, and times when they would not report or fill out a medication error report if they could "fix it" (FG5), which was similar to the approach described by nurses in Baker's (1997) study:

> *Sometimes you do and sometimes you don't fill out an error report. It depends on if you can fix it by giving the missed medication, you know better given late than never. Other times you have to look ahead and reschedule other doses of medications to get back on schedule for antibiotics. (FG5)*

> *Lots of times errors are wrong times and missed times with medications that are timed, because you may not even have the medication to give. Or you might be right in the middle of checking your charts at midnight, and you miss giving a midnight dose of a medication. I think most of our errors, like those given at wrong times, like our simple ones, that we say skip the incident report on, and we fix it right away by giving the med, so it's not an error anymore, because the med was given. (FG2)*

> *Everybody kind of handles things in their own way, if it's a once a day drug it may not have much impact to give it 2 hours later, but if it's something that's acute… and now this is 2 hours later it's a lot bigger impact on that patient. If you can't fix it you fill out one of those forms, or if the medication causes actual harm to the patient, oh then you really have to fill out a report, right. (FG2)*

Nurse participants revealed that they relied upon their nursing knowledge and judgment to determine when a patient could safely take medication, and

sometimes delayed medications based on situations (e.g. patient was off the unit) and their assessment (e.g. patient could not swallow meds). If a nurse delayed giving medications based on a patient's condition, this was not considered a medication error. However, if a nurse did not administer a patient's medication as scheduled and there was not a valid reason for the delay, this was considered a medication error. Two nurse participants explained that they would first try to ensure the patient received the medication, albeit the medication would be given later than scheduled:

> *It's happened where you know a nurse gives some med to a patient to take and the patient says "leave it for me to take with breakfast", and the nurse leaves it for the patient with their breakfast tray, you know, trusting the patient, and she signs for it and is gone. Then you come on shift, and notice the patient forgot or just didn't take it and it's like 2 hours later, oh about 8 o'clock in the morning when this med was scheduled for six. Maybe the nurse would write "not given" beside that signature and then write the right time with their own signature, that's probably what I would do. (FG2)*

> *I think how a nurse might deal with a late med depends on the level of risk for the patient that late medication has. Maybe their 8 o'clock in the morning aspirin didn't get taken, it's a once a day thing for a couple of hours, or was it the IV antibiotic for that meningitis or spinal abscess patient and you know it hung on the bard but did not infuse or was not started for 2 hours, I mean that has a lot more serious impact. So looking at the level of risk for the patient is going to determine how the nurse and manager will deal with it. (FG2)*

A nurse participant stated she was uncertain if formally filling out a medication error report to communicate about an error supported medication safety, as error reports did not visibly contribute to "fix problems":

> *To tell you the truth, I don't know where those reports go, so I am not sure those reports help with anything, because I think a lot of them are filed somewhere, and only used to count how many errors are reported, not fix problems. (FG2)*

The unit manager described how she responded to reports of medication errors, near misses, and occurrences that nurses handed in:

> *I watch medication occurrence reports that are handed in. If I see unusual errors or a trend in errors I have a firsthand opportunity to follow it up, not only with the individual who made the error, but also to alert others on the unit to take care in a certain area or with a certain medication. I also get reports of near misses, it seems like the nurses here are watching what goes on and will be alert for potential dangers, like when there are orders written that have unacceptable abbreviations for medications. Occurrence reports are filled out for everything, pharmacy errors, doctors' errors, nursing, even physiotherapy errors. (FG3)*

It was apparent that participants held diverse perceptions about medication errors, and about the value of filing a written report about a medication error that occurred. Nurse participants exchanged knowledge about past medication errors with co-workers and myself as researcher, but expressed that they did not know if completing an error report for all medication errors really made any difference in their practice, or fixed

problems with medication safety. Nurses expressed that "If you can't fix it you fill out one of those forms" (FG2) implying that if you detected that you made an error, completing an error report was akin to confessing your mistake because there was a possibility that a patient could be harmed, but if you could fix the medication problem, it was not an error. I wondered if nurses perceived they had limited power and had adopted the view that they did not necessarily have to fill out occurrence reports if they shared the information with others to learn from, and others potentially used this information to improve their own and others' medication practice. Sharing medication information was viewed by participants as more supportive of medication safety than putting a report in a sealed envelope that a participant expressed she did "not know where those reports go, so I am not sure those reports help with anything" (FG2).

The nurse manager, on the other hand, regarded medication error reports as a barometer of things that happened on this unit, and used these to confidentially follow up on reported breaches to medication safety with individuals and to flag trends in occurrences and errors with all nurses on the unit so they could watch out for these. The nurse manager did not reveal that she posted information about how many errors or what types of medication errors were occurring on this unit for all nurses to see, but rather she dealt with each individual report or trends in errors by communicating these to people in person.

Communication supported medication safety and was a component of unit culture that encompassed a variety of approaches to sharing information about

medications and translating medication information into action. In this unit culture, nurses spoke of valuing times when they discussed medications with patients as this was a rich resource informing what they needed to do to adapt their practice. Medication resources were posted and available to support to medication safety in this unit culture, both print resources and experienced nurses were recognized as resources. Nurses mostly relied on each other to check and verify that patients received medications appropriately, and nurses communicated what needed to be checked for oncoming nurses; this was considered an essential support for medication safety when it was carried out, but could be a risk when a nurse was relying on another nurse to flag or identify gaps in medication orders. Nurses called pharmacy technicians for medications, but pharmacy technicians did not routinely initiate communication with nurses about medications. This lack of communication could create situations where information would have supported medication safety for patients if it was not embargoed.

Communication about medication errors did not follow a consistent pattern according to nurse participants. Participants discussed medication errors they made with co-workers and peers during focus groups and photo walkabouts, perhaps to raise awareness about medication safety risks, but participants did not articulate that completing a medication error or occurrence report made any difference for others in this system. Based on this perception, nurse participants divulged that they completed a medication error report if they couldn't fix a medication problem, or if a patient suffered actual harm associated with a medication, but did not routinely fill out occurrence reports for missing

medications. This meant that nurses made judgments about situations and whether they would complete medication error reports as identified by Baker (1997). The nurse manager stated she watched for trends in the content of occurrence reports, and discussed each medication error report with the person involved in the error, so I questioned if a nurse wrote occurrence reports for each instance of missing medications, would this support the nurse manager to address this system issue with pharmacy, or someone with decision making authority? Communication through the unit grapevine or unofficial communication channels about medication errors as threats to medication safety seemed to be nurse participants' preferred method of information dissemination about medication safety risks. Cheek (1997) identified teamwork and communication amongst nurses affected medication administration, as did professional, contextual and client factors, and nurses' individual medication knowledge or anxiety about making an error. Stetina and colleagues (2005) reported that nurses used their individual contextual knowledge of hospital systems and unit routines to manage medication errors, indicating that medication errors were often intertwined with unit and system dynamics and practitioners working together. In the next segment teamwork as an aspect of unit culture, which influenced medication safety, was explored.

Teamwork. Teamwork, identified as a support for medication safety, was visible as nurses administered medications on their bay or team. For example, during one field observation, I saw teamwork in action as a group of staff nurses (who worked on this unit) returned to the unit after a break, and two nurses stopped at a medication cart standing in the hallway. One

nurse asked if the RN at the medication cart would like her to take over with meds. The RN replied: "I've poured these for (Patient X), so I will give them. I haven't done meds for Room 4 as that patient is on isolation and I would like to keep the traffic down in there. So if you go in there together, give the meds, turn him and do everything in one go, okay?" (FO21). During a subsequent field observation on one Saturday morning, a nurse participant turned to me and said "This is our greater family, people care about each other here, and we work well together" (FO23). When asked, this nurse participant revealed how as nurses and team members, decisions were made each day about which team member administered medications on a bay (RN or LPN):"well like now (Nurse X) starts at one end giving meds and I start at the other and we meet in the middle" (FO16). Nurse participants were assigned to care for a group of patients as a team. As one RN participant in a focus group described now both RNs or LPNs can administer medications, so medication safety for patients was improved for patients as they don't have to wait for one team member:

> *It's kind of good now that meds are given by both RNs and LPNs on this unit, because meds can be given at the same time each day as they are scheduled, patients don't have to wait for the RN for their AM meds, sometimes until 11 o'clock like they used to. (FG1)*

From my observations, there did not seem to be an accepted routine to determine who would assume responsibility to administer medications to which patients on a bay; but neither did there seem to be one person

responsible for bathing patients or changing dressings for a designated group of patients on a team. Rather, tasks were negotiated between team members each day, or decided on the spot. I reflected on this situation, recognizing that as a nursing instructor, I wanted to see a process whereby one nurse was clearly responsible to administer medications to certain patients; this was not visible to me.

A pharmacist participant mentioned that a pharmacist's clinical work was more effective in supporting medication safety when she established trusting relationships and participated in knowledge sharing and development with nurses on a hospital unit as a member of a team:

> *A pharmacist can influence medication safety at the ground level by establishing relationships and solving problems, this takes place over a span of time. As pharmacists, we cannot just donate time on a visiting basis; we must carry through and monitor patients' outcomes with medications to develop knowledge of medications and patients, on a unit, and be part of the health care team. (FG7)*

This pharmacist participant was often present on the unit and observed responding to nurses' questions, visiting patients to discuss their medications, and contacting physicians about medication orders. Also during observations, the nurse manager, charge nurse, and clinical nurse specialist were frequently seen making nursing rounds, visiting each patient on the unit, and discussing nursing care with individual nurses. From these observations, I gathered this nurse manager collaborated with and mentored nurses on the unit while promoting teamwork, in a unit culture where the

quality and effectiveness of nursing care to promote patients' health and recovery from surgery or illness were constantly monitored. (FO9)

Nurse participants expressed expectations that they and other nurses as team members supported medication safety by doing real-time chart reviews focused on medications and patients' conditions. This shared expectation, as an aspect of teamwork and unit culture, was passed on to new RNs during unit orientation as they were coached "how to check charts at night" (FO21). One RN participant described how she taught newcomers to focus on medications' effects:

> *When I orient a new RN to the unit, I show them how to check charts at night. I tell them to question everything, and then we go through a patient's chart together. For instance, I ask things like 'why is this patient having so many loose bowel movements?' and 'are the medications that are ordered for that patient causing his rash?' and 'why is this patient getting so much liquid muscle relaxant, are we giving the correct dose?' (FO21)*

Teamwork supported medication safety, as these examples indicated. Nurses on a bay seemed very comfortable trusting another nurse and team member to take over administering medications to patients on their team. However, the on-the-spot determination about which team member (RN or LPN) would administer medications on any given shift could lead to medication errors if one nurse thought the other had administered a patient's medication, when no one actually had. A pharmacist indicated that becoming a part of a team on a unit improved medication safety for patients. Nurses were seen consulting with other nurses during rounds, and nurses coached new nurses in the ways nursing work was

carried out (e.g. checking charts). The nurse participants emphasized that communication was key to ensuring medication safety for patients; teamwork, communication and learning contributed to cultural integrity on this unit. However, given the teamwork, communication strategies, and unit learning practices observed or discussed by participants, many practitioners expressed conviction that when it came to system issues with medication safety, they had little power to make changes in the system.

Practitioners perceived limited power to change the system. Nurse participants commented early in this study that they could adjust or modify their own practice when they identified medication safety issues. However, none of the nurses taking part in the research initially expressed that they had the power to modify structures or equipment in their unit environment or effect changes to improve the medication system. For instance, one nurse participant discussed a problem she was trying to fix with a malfunctioning IV pump, and she said "There are ways around it. But I think often nurses just work with what is there, when it might be safer to find ways around the equipment or the system." (FO5). Later, another nurse participant indicated that she felt nurses could control their own actions, but not control or change aspects of the medication system: "I just think that sometimes we have certain equipment, and we nurses work with what we have, you know, sometimes we can't control what we work with, but we can organize our own actions around things" (FO12). These comments indicated the way nurse participants viewed their power (individually and as part of this unit's

culture) or lack thereof to deal with recurrent problems with equipment or their environment.

Juxtaposed with early observations were the nurses' reactions to the socio-technical devices implemented for patient lifting; as one nurse participant pointed out "Did you see the ceiling tracks put in all the patient's rooms? I didn't hear any nurse say, 'don't do that, its technology'; they're wonderful" (FG5). Nevertheless, as practice community members, nurse participants confidently described what they did in their practice to ensure medication safety for patients on this unit as this research began. Nurse participants did not mention how they had or could change the system to improve medication safety; they only identified how they modified their practice in response to system problems, technology, and equipment as they worked with patients.

Pharmacist participants similarly did not express how they could change any aspects of the system other than their own clinical practice. In fact, several participants spoke of wanting to have a particular dedicated pharmacist assigned to work on this unit consistently, which was viewed as one way to consistently improve medication safety. However, one pharmacist informed me during a field observation that their current collective (union) agreement was silent on the topic of a pharmacist being assigned to one area in the hospital as a clinical pharmacist: "we do 8 hour shifts and we take call. I just came off working 7 days plus call and had 1 off and now I am back. Our collective agreement is silent on rotating shifts for us. If I trade with another pharmacist, we get an email asking why" (FO22). This pharmacist expressed she could not control her own shifts, much less change

pharmacist assignments in this system. From observations, it would be beneficial to have a consistent, knowledgeable clinical pharmacist assigned to this unit.

A pharmacy technician participant pointed out that their main work priority was to provide medications to patient units as these were ordered, and in fact their current role had "evolved" as they were no longer "portering systems" taking medications to units (FG6). Technicians organized and monitored their work in pharmacy around this stated priority, but did not discuss with me their capacity to effect meaningful systems change in terms of medication safety. I questioned how pharmacy technicians interacted with nurses on patient units, and was informed that although technicians had some frustration with nurses "calling and bugging for meds right away" (FG6), they did not respond. As a result of the changes to pharmacy technicians' work responsibilities that were discussed earlier under the theme of embedded accountability, pharmacy technicians were not often present on units, nor considered members of this nursing unit team and culture. By their absence, any suggestions that pharmacy technicians had for medication system change on units to move medication safety forward from the present would be looked at askance.

At the beginning of the study, a number of participants characterized unit culture by stating that they could not effect changes to the system. Later, in selected areas, participants offered ideas about what they would change and restore in their system to improve medication safety. These ideas are discussed fully in the final theme.

In summary, the theme of unit culture emerged as participants expressed their ongoing desire to acquire knowledge about medications, and to learn and adapt their practice to achieve medication safety for patients. Nurse and pharmacist participants described how effective communication and teamwork enhanced medication safety in this unit culture, and conversely, nurse participants did not generally regard medication error reporting as an effective support for medication safety. Pharmacy technician participants described that communication with people on nursing units was ineffective at times; however, there were no suggestions as to how to improve communication to improve medication safety. Furthermore, while nurse participants described the unit culture as cooperative and collaborative early in the study, they stated that they did not think they could make changes to many aspects of their work environment. This sense of constrained power in relation to effecting system change may partially explain the prevalence of the next findings, which I came to cluster together in the next theme as a phenomenon of workarounds.

Theme Five: Workarounds are a Way of Life

Throughout the research, and in relation to all of the other themes, practitioners discussed a range of workarounds that they devised to address ongoing barriers to medication safety which they encountered in their practice. The term workarounds in this context referred to any non-standard practice or process that practitioners used to prevent harm to patients and accomplish work in this medication system in light of health system, organizational, unit, or situational constraints (see discussions by Berte, 2007; Koppel et al., 2008;

McAlearney et al., 2008). Vogelsmeier, Halbeslesben, and Scott-Cawiezell (2008) described how practitioners in five nursing homes devised "workarounds to circumvent interruptions to workflow" (p.114) following implementation of electronic medication administration records (eMARs). In organizational safety science, a scholar identified workarounds as individual's efforts to accomplish work when standard operating procedures were ineffective and barriers to optimum work flow were encountered (Rasmussen, 1997). In this sense, workarounds are used by workers to circumnavigate workflow problem areas and overcome systems deficiencies; however, workarounds do not solve underlying system problems.

Workarounds were comparable to Amalberti, Vincent, Auroy, and de Saint Maurice's (2006) conception of violations as "deliberate deviations from standard procedures" (p. 66i). Practitioner participants discussed workarounds that were devised and used to overcome problems encountered when documenting medications, and with the PIP. Two other workarounds were apparent in this study, which I describe as system workarounds: firstly, nurse participants devised and used a system workaround to overcome deficiencies in the medication delivery system that resulted in missing medications, and secondly, decision makers devised a system workaround whereby patients were placed in hallway beds on units when the emergency department was full and overflowing.

Working around documentation guidelines. A workaround was developed to address problems encountered when two or more nurses administered medication on the same team at the same time on this unit. Problems

were encountered when practitioners followed sequential steps for medication administration and documentation that are found in a nursing fundamental textbook (Potter et al., 2009). These standard operating procedures require that nurses sign off and document the time when a medication has been administered in a patient's MAR after the patient has visibly received and ingested the medication. However, nurses on this unit indicated that they encountered problems when one nurse administered medication to a patient, and then another nurse from the same team came along and administered the same medications to the same patient, if the first nurse had not yet documented administering those medications. This inadvertent double dosing of some patients could occur when more than one nurse administered medications from the same cart to the same patients at the same time. Practitioners therefore devised a workaround to address potential risks to medication safety from inadvertent double dosing, which they discussed freely in the first focus group:

> *When I go to give the meds, I put the exact time, like the time when I put the medication in the patient's medication cup, so that I know it is put in the cup, and then I sign my initials in the MAR. (FG1)*

> *Sometimes I sign after, sometimes before, I'd rather sign when I put it [a pill] in the cup, because the ramifications of someone coming along when I've forgotten to sign it afterwards and giving it twice is worse than the patient refusing it after you sign for it, or spitting it out or whatever, you can fix that by writing refused or vomited or whatever. (FG1)*

> *I sign the time and my initials when I pop them in the cup too, because I am doing it right there in the patient's sight. Then I know I have put that*

one in the cup, and if someone interrupts me then I know and especially if they have 20 plus pills. They [pills] don't always come up in order from pharmacy, so you are searching in the cassette or flipping back and forth on the MAR and you could be missing some. That's why I note each pill when I take it from the package and put it in the cup. (FG1)

This workaround was not used by all nurses practicing on this unit all the time. A nurse participant described that it depended on what medication was to be given and on the patient; there were advantages to following standard operating procedures with, for instance, antihypertensive medications:

There are times I don't do that [sign for meds before administration]. Like when it is a single blood pressure pill, I don't put it in a cup. I leave it in the package until I take that person's blood pressure and chart it on the MAR right beside the time the pill is scheduled for. And this also helps me when the patient then asks you "what is the red pill" when you get to the bedside. I don't have to go check what the red one is, because I can read the name of the pill on the package, not have to really remember the color of each one. (FG1)

While the merits of avoiding double dosing patients were self-evident, participants acknowledged that when they documented medications were given before administering them to patients, there were inherent risks. There was a risk that a nurse could document that medications were administered, when in fact they were not administered, because a patient did not take pills that were left for him to take, or a patient's medication did not infuse in their intravenous. Nurses using this workaround might therefore have to be more vigilant to ensure medications were in fact administered to a patient after pre-signing their

administration. In addition, this workaround does not address a fuzzy system requirement for a clear designation of who is responsible to administer medications to which patients on a team on a daily basis. With no standard system for deciding and communicating who will administer medications, the risk for double dosing patients or assuming that a team member administered medications to the other patients on a team persisted.

Working around physician order writing on PIPs. According to the provincial medication reconciliation system guidelines, a PIP lists patients' previously filled prescriptions and can be accessed for review with patients upon admission to hospital, at transfer points and at discharge. However, nurse participants indicated that physicians sometimes used a PIP to order patients' medications after admission. Confusion arose over what medications and what doses a patient was actually taking, and what should be ordered from those medications listed. Nurse participants identified problems when they reviewed a patient's PIP upon transfer to this unit, some problems related to timing of medication reviews, some with communication about medications, and with physicians re-ordering medications on a PIP after orders were initially completed as a patient was admitted:

> *The problem with a PIP is it's not filled out clearly in the first place, or not filled out properly, you either see a medication and it doesn't have a dose, or you don't have the interval that the person has been using, or you never know when they've last taken it, cause you see that the person didn't say on admission. Or did they last take it? And then some things*

> *are crossed off, but it doesn't say stopped, or it doesn't say anything. (FG5)*

When there was incomplete information on an initially completed PIP, or on another medication list a patient brought, a nurse participant described that she had many questions to reconcile patients' medication information with a patient transferred to the unit:

> *One patient came in with a handwritten list of meds, and she said to me, oh, I don't know why I am taking that, or I take three of those, but on the PIP it is take one once a day and you are taking three of them, like why? That is when it is good to have a PIP printed out, and you can ask a patient if you see something on the list that is inconsistent with what is on the PIP, like have they updated their prescription or their dose, or refilled their prescriptions for everything, and what do they actually take now and how much, how often? (FG5)*

A PIP was designed to provide a place for physicians to order medications that a patient had been taking before admission to hospital, only when the patient was admitted. Medication reconciliation guidelines do not indicate physicians can change medication orders on a PIP after a patient was in hospital, albeit physicians still ordered medications for patients on PIPs after admission sometimes. The problem with physicians working around medication guidelines for ordering medications on PIPs was that medication ordered or re-ordered on a PIP could be missed or not processed on a unit.

Nurses devised a way to circumvent physicians ordering medications on completed PIPs after patients' initial medication orders were received. A nurse

participant suggested she drew the physicians' attention away from the PIP towards a list of patient's medications on a nurse's ask list. One nurse participant described how she avoided having a physician use a PIP to reorder a patient's previously prescribed medications:

> *A doctor may just sign to reorder everything on a patient's PIP. But with some doctors, I don't just give them the PIP for a patient that we get transferred here, I just put the meds that the patient tells me that they were taking on our ask list and tell the doctor the patient told me they were taking these meds, and the doctor can decide. I find that works better, because it seems some doctors will just sign to reorder meds on a PIP and others won't sign them at all, and no one should be using them to order meds after they are completed the first time when a patient is admitted. (FG5)*

It was clear that this maneuver could potentially reduce the possibility of physicians working around PIP guidelines and writing medication orders on PIPs after admission. However, a potential drawback from this maneuver was that the underlying difficulties with the PIP would not be addressed or even clearly identified if only nurses on this unit united to divert physicians from re-ordering medications on completed PIPs. Physicians could easily continue to work around medication ordering guidelines on a PIP available elsewhere. These problems might be addressed if physicians could update PIPs electronically, or could enter their own medication orders into a pharmacy system with patient profiles that prevented order changing on PIPs after admission.

A system workaround to address missing medications. Nurses and pharmacy technicians, each in their own units, devised workarounds to overcome problems associated with missing medications. These workarounds were attempts to ensure that medications would be available when patients required them, at times when the system did not provide for practitioners to gain quick access to appropriate medications. In order to ensure nurses have access to medications to administer to patients when medications were missing from patients' cassettes, nurses devised a medication 'banking system' where they saved extra medications from cassettes after patients were discharged and before pharmacy technicians collected these medications with the daily cassette exchange. A variety of unit dose packaged oral medications were banked and kept in a secure unmarked location that all nurses on the unit were familiar with and could access when medications were missing from their patient's cassette. Nurses devised a system workaround whereby they deposited and withdrew medications from this bank of surplus medications (Figure 4.25) when needed to provide patients' medications as ordered, but which were not available from pharmacy. One nurse participant described this medication bank:

> *We have a place where we keep extra pre packaged medications that have been dispensed from the pharmacy but were not needed for our patients, maybe they were discharged before the med was scheduled to be given. We go to these when we are missing meds that have been ordered, and it wouldn't be ideal for the patient to have to wait for the medication to come from pharmacy. (PW4)*

Figure 4.25 Photograph # 67 Saved unit dose packaged medications, PW4

Nurse participants responded to this photograph of saved medications during photo elicitation groups, by verbalizing their assessment that they needed to keep medications in reserve for times when medications were missing due to system design flaws. It seemed participants did not trust that this unit dose medication system was designed or equipped to provide medications to units expeditiously for patients. The nurse manager on the unit described this photo as "our workaround" (FG7) indicating that she knew of these medications banked on the unit. Participants who viewed this photograph often cited this medication bank as an option when a patient's medication was ordered but missing. One nurse participant referred to their medication bank as a commonly shared secret on this unit, where nurses accessed medications to replace medications that were missing

in patients' cassettes "That's where we go for those meds that we are missing, but don't show this to anybody" (FG5). Other nurse participants described they could access medications from their reserve as an immediate solution to missing medications, or let the medication system respond to missing medications and "risk the patient being harmed" (FG5):

> *When meds are missing from a patient's cassette that are due to be given, you can either go to the meds we have kept here and get the med and give it to the patient at the time that it is scheduled by pharmacy. Or you can wait, and make the patient wait for the med and risk the patient being harmed or experiencing some discomfort, and then you can fill out an incident report because you gave the med late. (FG5)*

> *Well that photograph of medications makes me think of the comparison to the cassette with medications that hardly has anything in it, because often there are missing meds in the patient's cassettes and it takes a long time to get them from pharmacy. And you weigh whether it's worth the wait for about 2 hours when you have a missing med that was due at 10 and you know it won't probably get to you until noon, or you just can take it from here. (FG5)*

Pharmacy technician participants freely acknowledged that they knew nurses kept extra medications on hospital units for times when replacements for missing medications were required. In a focus group discussion, pharmacy technicians expressed concern that these retained medications could be expired or recalled by the manufacturer: "We know there are stashes; we find them every once in awhile. But is that medication in stashes expired, or is it from a batch that has been recalled?" (FG4). This comment made me wonder if pharmacy

technicians communicated drug recall information to nursing units, when they learned about drug recalls. One pharmacy technician participant stated if medication stashes were found they would be confiscated. This made me wonder if one of the reasons that this medication bank was necessary was the well known delay in delivering medications to units after these were ordered, and how nurse and pharmacy technician participants had admitted that medication deliveries were tardy and they did not check or expect much from the pharmacy drop off box. Pharmacy technician participants agreed that limited pharmacy hours of operation meant that medications were not available from pharmacy at all hours of the day and night. One pharmacy technician participant admitted "we do the same thing with stashes" in pharmacy to keep reserve medications to cover medication delivery system deficiencies:

> *They [nurses] don't get that because they work twenty four hours and we don't, we can't always be here to send meds. I don't blame them for wanting meds and they are waiting, that is why they have stashes. We do the same thing with stashes, we have extra of certain stock meds, because we don't want to run out. I don't want to phone another hospital every day for Atrovent. Like I get it, but it's just the way it is. A pharmacist is going up to the units where they are assigned, and they will pick up those orders, priorize and start to enter. But nursing is calling and bugging right away for those meds, so we can imagine they are going to a stash for meds if they have one. (FG6)*

Nurse and pharmacy participants indicated the medication system in this hospital was designed to have secure storage for certain medications, but not all medications. The medication bank was kept in a secure location that only

nurses working on this unit accessed, providing a measure of medication security not available for medications in the pharmacy drop off box, patients' cassettes, or on medication carts. Accordingly, this system workaround had both merits and drawbacks. A merit was that practitioners ensured and secured an accessible supply of medications for times when medications were needed but not readily available for patients (e.g. missing medications). A drawback of this workaround was that it worked so well to address the problem of missing medications, and was widely known as an effective stopgap to a deficiency in the medication system design, there was no visible alternative proposed to change the system to address the larger issues of missing medications on units, or medication delivery deficiencies.

An associated system workaround that nurse and pharmacy technician participants engaged in was the tacit avoidance of the pharmacy drop off box. Participants openly stated earlier that they avoided taking medications out of the pharmacy drop off box. Neither nurse nor pharmacy technician participants expressed that they had ownership of the box, or its' contents, and so often medications delivered to the box rested there for hours. This workaround of ignoring or neglecting medications in the pharmacy drop off box was likely related to the pharmacy medication delivery system that was seen as inefficient.

A system workaround to accommodate overcapacity patients. In my first theme of unit structures, nurse participants described a not uncommon occurrence when a hospital coordinator in charge of patient admissions notified

nurses that a patient was on the way to this unit to be cared for in a hallway bed, even though all beds on this unit were currently occupied. This system workaround to standard hospital patient admission procedures placed patients in other than bona fide patients' bed spaces, without access to standard features associated with hospital beds such as oxygen and vacuum outlets, electrical outlets for pumps or monitoring devices, washroom facilities, and a patient call system to call for assistance. When the emergency department was overcapacity with more patients than that department had spaces for, patients were placed on stretchers lining emergency department hallways, and with increasing frequency patients were placed in unit hallways. This system workaround could benefit patients by moving them out of emergency department hallways, but could also compromise these patients as they did not usually have a choice where they were being placed, considering that they were seriously ill enough to warrant admission to hospital. Patients were often placed in hallway beds on units for what was hoped would be a short stay; however, for the time these patients were in hallway beds, they did not have guaranteed access to standard hospital amenities (such as oxygen, vacuum, nurse-call systems, privacy, security for their belongings, or dedicated washrooms to take care of basic hygienic necessities). These were the most obvious drawbacks to this workaround for patients. Other drawbacks to placing patients in hallway beds on units included that these additional patients and their medications were added to a nurses' workload to be accommodated as they could be, and this practice diluted the amount of nursing every patient on a unit received. This workaround did not address the larger system issue of a

recurrent insufficiency of available beds for patients entering hospital through the emergency department, or where to locate these patients in bona fide hospital spaces.

In summary, the workarounds that nurses and pharmacy technicians discussed were devised to overcome problems with medication and overall system design and involved the development and execution of innovative ways to accomplish goals in response to system problems, or to prevent harm to patients from inherent risks. Participants readily discussed what and why medication system workarounds were devised, demonstrating that participants and decision makers used on-the-spot solutions to ensure patients received the benefit of appropriate medications ordered and administered in a timely fashion, while avoiding the hazards associated with missed medications, inadvertent double-dosing or duplicate or missed medication orders. Participants were aware of reasons why decision makers worked around standard admission procedures for patients, although this system workaround was perhaps viewed as the lesser of two poor solutions to an immediate problem. Clearly, each workaround engendered some degree of risk to medication safety, but workarounds had become a way of life for many on this unit. For example, there were risks to keeping a medication bank or stash on a nursing unit, as there was no guarantee that a medication missing for a patient was in there, or that a medication from the bank was the desired dose, and not expired or recalled. However, nurses spoke of weighing the risk for adverse medication events against the possibility of patients missing their medications, and often decided to use their practice to fix problems

at that time to ensure medication safety. Nurse participants did not consistently engage in any or all of these workarounds, as they recognized these could introduce further risks to medication safety.

Perhaps most importantly, participants related workarounds to the need for medication system design improvements. This recognition of the link between workarounds and system barriers leads to my final theme, where despite participants' earlier expressions of disempowerment; several participants envisioned and shared ideas for potential improvements to strengthen medication safety on their unit. In fact, a number of participants expressed optimism that at least some of the changes to unit structures and medication system design they recommended could be considered and implemented.

Theme Six: Practitioners Can Envision a Variety of Improvements

As a researcher, implementing improvements was beyond the scope of my research. Participatory methods with practice community members allowed me to focus on and examine medication safety with participants on their unit, and to listen to their thoughts and discuss ideas with them. I questioned "what would improve this" when participants identified barriers to medication safety, I listened as participants generated and discussed improvements, and what could potentially strengthen medication safety. Participants came together, viewed photographs taken during the study and engaged in earnest and lively discussions. Notably, several research participants implemented some changes as my data collection concluded. Participants' suggestions for improvements are grouped here into

potential or implemented changes to medication resources, unit structures, and medication system design.

Participants re-examined resources. Participants suggested access to specific medication resources with up-to-date medication information was needed to maintain participants' ongoing knowledge development, sustain a culture of learning about medications, and sustain medication safety on the unit. A nurse participant pointed out a new medication reference placed in binders with the MARs in response to discussions in a focus group: "We have a new chart for comparison of opioid analgesics included in each MAR binder as a learning resource, and there is a poster showing the differences between narcotics situated in the main medication room on the doors to the narcotic cupboard." (FO13). Nurse participants described that a new medication resource was available on the pharmacy website, but could be hard to read:

> *There is a compatibility chart on the pharmacy website, but the meds are difficult to see when you have such a huge chart to display on a computer screen. You know, you shouldn't have to try with your bifocals and trifocals to line up the lines, like does this go there or does it go with that drug, where does it meet? Although if you were trying to follow a line down to see where it intersects with another line on a computer you would have to scroll because the font would be so fine, so with scrolling down you might lose your safety, by mixing up what goes with what, you know, what is compatible? (FG5)*

Practitioners shared their ideas for improvement to develop patient discharge medication plans that would draw on technology and resources already available in the medication system, and build a dedicated medication list for each

patient to be given as they left hospital. A nurse participant questioned if a form similar to a PIP could be generated with patients' medications:

> *If it is possible to print PIPs on admission, why is it not possible to pull something from the computer for patients being discharged that would serve as a printed list of discharge medications? Every medication ordered was entered by the pharmacist into their program, which is why we get MAR's. How hard would it be to have something like that for the patient to have as a paper to take home and to show their GP after discharge? (FG5)*

A nurse educator participant shared information in a final focus group that a discharge list of medications that would "go along with the PIP" (FG8) was being planned to give to patients as they were discharged to improve medication safety. I wondered if nurses, pharmacists, and physicians collaborated to design the new discharge medication list for patients or new MAR format for nurses that was being generated by pharmacy, or if a discharge medication list would be made available for all patients discharged from hospitals as a provincial initiative:

> *Pharmacy is setting up a discharge list for medications that will go along with the PIP, so there will be a list of discharge medications that can be printed and given to the patients. And there will be a new 24 hour MAR, so they are setting it up differently than what we have now. (FG8)*

Several pharmacy participants suggested pharmacy resource improvements to support medication safety. For instance, one pharmacy technician stated "It would be good for pharmacy to get a dedicated porter to bring meds to units, so they wouldn't have to wait for a porter from central dispatch to bring meds to the

unit" (FG3). A pharmacist participant wanted to see physicians, pharmacists, and nurses routinely participate in interdisciplinary rounds to improve medication safety, where patients were included in a discussion of plans for their hospital care and medications ordered (FO16). A decision maker participant suggested that physicians, pharmacists and nurses making rounds on the unit together would enhance medication safety for patients, as would clear communication and "good physician hand writing" (FG3):

> *I'd like to see timely rounds by physicians, with the pharmacist and nurse on board, where physicians share their knowledge of medications ordered as they have a good rationale for changing medications for particular reasons, this speeds up the process of recovery for the patient to get medications as ordered. Advantages of physicians making rounds with pharmacists and nurses is of course better communication, patient teaching and access to meds to assist earlier discharge. ...oh and it would be good to bring back good physician hand writing [laughter]. (FG3)*

When participants got together and envisioned system changes, their first suggestions were to increase or expand the scope of current resources provided in this system that they were familiar with, such as information resources. Nurse participants wanted improved medication information resources to support their work and to share with patients as a printed discharge list for each patient's medications. Pharmacy technicians recommended hiring a dedicated porter to deliver medications to patient units. A pharmacist suggested routine interdisciplinary patient rounds would improve patient safety. The suggested resources to improve medication safety were essentially resources to support

practitioners' or patients' learning about medications, to hasten medication delivery processes to hospital units, and to support communication and teamwork about medications. During the course of my study, nurse participants freely shared their stories about medication errors, and although practitioners did not mention this as a way to improve medication safety, practitioners could continue to help their colleagues avoid similar mistakes by exchanging stories and learning from each other. These improvements suggested by practitioners and decision makers signaled that practice community members were moving towards ecological integrity as they improved medication safety in their shared place, while looking after each other with attainable and sustainable resources (see Marck et al., 2006c). Practitioners widened their gaze to surrounding unit structures and shared ideas for medication safety improvements.

Participants reconsidered unit structures. Participants envisioned a range of changes to unit structures to improve medication safety. Nurse participants discussed that they would like the supplies on the IV solution supply cart in the clean service room re-organized (see Figure 4.26):

> *This is our cart with IV supplies in the clean service room now, it could be arranged to be more user-friendly, because sometimes it's hard to find the IV solution you need in a hurry. Sometimes we just stand there looking for the solution we want, and we can't see it. (PW2)*

> *Our IV supplies in the clean supply room are on carts that are restocked by someone from stores. I would like to have similar items stored together, so that a nurse does not have to hunt and gather from many different locations for supplies for one procedure. We are not supposed*

to move the supplies. I will negotiate with stores to re-arrange the cart supplies. (PW4)

Figure 4.26 Photograph #37 IV solutions on storage supply cart, PW1

Nurse participants exchanged ideas and shared their actions to "remove the clutter" (FG8), organize medications and supplies in work areas and structures, including the medication room and refrigerator. One nurse participant described that cleanup had already started and would support medication safety: "In the med room, we have taken all those restraints and what not out and cleaned those shelves by the door up, because we now have a new secure area where all that can go" (FG7). Other participants in focus groups corroborated that unit medication clean up and ideas to organize medications were not confined to one area or medication room:

We have already gone through the medication rooms both the one by the main nursing desk and the small one on Bay 2 to remove the clutter and organize things into a more useable fashion. And we labeled the medications on the shelves clearly. (FG8)

On the door of the med room fridge, in that blue bin, it would be kind of nice but it would also be space consuming to have a separation between the kinds of insulin, and not rely on the color of the tab on the top of the vial of insulin. And then maybe the separated compartments could be labeled. (FG7)

Nurse participants during early data collection asserted that they mostly worked with supplies on medication carts as provided and as they found them, as someone else put the supplies where they were located. However, when nurse participants viewed a photograph of one medication cart in the second set of focus groups, they described how they would work together to clean up, reduce clutter, and organize supplies so these would be standard on medication carts. As one nurse participant expressed, "I guess we all need input into the design of the cart, maybe, like where we put things" (FG5). This nurse participant identified and questioned supplies that could be cleaned up and rearranged to improve medication safety for everyone using a medication cart:

The clutter on the top of the (med) cart, the 14 pens that are on top there, are they really necessary? And does that pill crusher have to be there, you don't really have room to open the book (MAR) or to open the drawers, to get your medications. Your space is very limited (on top of the carts), there are lots of times when you are knocking stuff over. Like could that hand-cleaning gel not be on a hanger on the side? (FG5)

One nurse participant wanted dividers between medications installed in drawers to improve medication organization: "Well, looking at those drawers [see Figure 4.7], there is room for dividers, so why are there not dividers in there, where are the dividers?" (FG5). Another participant suggested cleaning the cart drawers: "I think that the stock med drawers on the med carts need to get the kind of cleaning that is required considering the spectrum of bacteria that we have" (FG7). Nurse participants confidently asserted that they would clean up and reorganize medication carts: "Well, that problem with all those meds in that drawer will end, because all that will be reorganized and cleaned up" (FG8). When the nurse manager viewed photographs of medications on medication carts, she suggested she could replace two of the older medication carts with standardized carts as she worked with nurses reorganizing their medication supplies:

> *Well, our carts at this moment are not all standardized, but I have been given permission to order and replace the two old med carts, because as we move forward with our reorganization and if we are going to the trouble of thinking everything out and standardizing it, we need to have the props to do it. (FG7)*

When participants focused their collective attention on areas and structures in their unit environment, they identified real and potential barriers to medication safety that affected their practice, and envisioned ways to improve unit areas and structures, and restore safety for everyone's benefit. Nurse participants envisioned a reorganization of the IV solutions on the supply cart in their service room so IV supplies would be grouped with similar supplies, and improve accessibility of IV

supplies to themselves as end-users. Practitioners envisioned cleaning up the clutter that had accumulated with medication structures, and put agreed upon ideas into practice as they removed non-medication equipment from the medication room, cleaned up medication storage areas, and labeled and separated medications in medication carts. Next, participants considered current challenges associated with medication system design and discussed possible improvements.

Medication system design innovations suggested. Possibilities for improvement were put forward by participants in the areas of increasing resources and improving unit structures. The current medication system design presented a challenge and participants mused about ways to improve this. I pondered if practitioners had been consulted in the past for their thoughts about medication system design changes.

Pharmacy technician participants proposed that this unit purchase and install an automated medication dispensing cabinet to provide nurses with ready access to medications, while maintaining medication security. Technicians filled and monitored medication use in automated medication dispensing cabinets purchased by four other units in this hospital. During a field observation, a pharmacy technician participant suggested:

> *This unit should get an automated dispensing cabinet for medications where nurses could access the medications stocked in the machine twenty four hours a day. This could potentially address the number of phone calls to pharmacy for missing medications, reducing work interruptions for both nurses and pharmacy technicians. (FO15)*

This pharmacy technician participant posed other arguments to convince practitioners of the advantages an automated medication dispensing machine:

> *Advantages of Pyxis machines are the records from the machine are automatically printed, so the nurse does not have to sign on a MAR. They don't sign, what they are doing is a blind count every time they access the pocket [or drawer] to use any med even a narcotic. Nurses do not have to call pharmacy for medications that are outside of ward stock for a patient, this cuts down on stat medication calls to pharmacy, missing medication calls, and medications don't have to be sent to a nursing unit by a porter. The security of the drugs in the Pyxis machine is an advantage; all drugs are recorded, so people can't just borrow meds because we have a record in pharmacy of every drug and everyone who accesses the machine. (PW3)*

Several participants expressed their doubts that a Pyxis machine would in fact improve system design for their purposes, indicating they were not convinced that an automated dispensing cabinet could improve medication safety. Participants stated they could not envision taking medications to patients in their rooms with the ease that they currently employed with medication carts, as nurses would need to queue up to access their meds from one machine:

> *I can see it (automated dispensing cabinet) is an advantage for pharmacy inventory control, I think it decreases medication administration safety, for nurses, because if the best practice now is to be close to the patients, that is eliminated. (FG7)*

> *Well, the fact that a nurse can move a medication cart right to the door of the room is a plus for medication safety now, you can't take a huge automated dispensing cabinet to a patient's doorway, or at least not the*

ones I have seen. And a lot of medication safety hinges on the nurses' assessment of the patient at the time that they are preparing their medications at the point of care. (FG7)

A pharmacist participant pointed out problems that had been encountered in other units with Pyxis machines with missing medications, and times when nurses would have to try to fix the machine if it malfunctioned, similar problems were documented by Balka et al (2007):

Pyxis machines cannot possibly have an entire pharmacy in a Pyxis machine anywhere, which means that there is always something that is not there. The Pyxis machines also tend to have some technical difficulties on occasion, with drawers that won't open, and getting jammed, so you really need someone on site that can service the machine twenty four hours a day... which at this point really falls on the super users who are nurses. So with the Pyxis, we (pharmacists) would expect that nurses would develop workarounds in order to fix a jammed machine so they could get the patient's meds. Ironic isn't it? (FG7)

It was clear to me from the vigorous discussions that community members were not convinced that an expensive automated medication dispensing cabinet would improve medication safety on this unit. However, this discussion about medication administration technology did lead to discussions of technology innovations that could improve medication system design. A pharmacist participant suggested that electronic medication order entry for physicians on patients' electronic charts would improve medication safety "I think eventually we will get physician order entry" (FG6). In addition, electronic MARs were also put forth as a potential system support for medication safety when electronic

documentation could be expanded system wide. As these innovations were raised, participants neither endorsed nor dismissed these ideas, but adopted a wait and see approach, as these would be considered system design interventions that would be engineered, implemented, and supported beyond the unit level and beyond participants' usual sphere of influence.

During field observations, a representative of the health region's information technology (IT) department suggested that computerized physician order entry (CPOE), and electronic medication administration records (eMARS) could be implemented system wide within five years (FO12). Nurse participants discussed electronic medication safety supports that they had worked with, noticed, or heard of elsewhere:

> *I have heard of places that have eMARS where the MAR is on a computer, maybe on a cart, and the nurse has a barcode scanner that you scan the medication, the patient's MAR, your nametag and the patient's name band with the scanner, and it beeps and you give the med to the patient. I'd like to see that here; we already scan our nametag for chems [blood glucose testing]. (FG5)*

> *Some patients now look everything up on the internet, and some of these new nurses are looking everything up on the computer, or their blackberries. The technology is there, we could use it for meds. (FG5)*

When considering medication system design, participants were very open in discussions about possible changes that could improve medication safety; they were frank when they stated they had not given the medication system much thought until now. Participants exchanged ideas about suggestions for electronic medication system design innovations that could improve

medication safety for example physician order entry, eMARs, and automated dispensing cabinets. Pharmacy technician participants extolled the benefits of automated dispensing cabinets for nurses, however, pharmacist and nurse participants expressed skepticism that an automated drug dispensing cabinet would improve medication safety as a one-size-fits-all system solution, or even remedy current problems with missing medications.

In summary, throughout the research, participants generated, discussed, and debated a wealth of ideas to improve medication safety on their unit that were presented in this theme. The changes they envisioned, and in some cases implemented, ranged from high impact but inexpensive practitioner-led clean ups that demonstrated their collective desire to improve medication safety on their unit for everyone, to feasible strategies for exchanging knowledge and team resources more effectively, such as conducting regular interdisciplinary medication safety rounds. Participants shared ideas about actions already under way to clean up and label medications stored in the refrigerator, medication rooms, and medication carts, and they wanted to have IV solutions and supplies reorganized into clearly labeled and similar areas on supply carts in the service room. The potential advantages and disadvantages of other more costly, system wide changes to the type of delivery system (cart based or Pyxis) or electronic supports such as CPOE or eMARs were openly debated without reaching consensus about which innovations might best support medication safety for people in this practice environment. Given the indication that some technological

changes were imminent, it seemed important that practitioners continue their communal discussions about potential system changes as this research concluded.

Chapter Summary

The findings presented and discussed in this chapter offered rich insights into how practitioners viewed complex influences affecting medication safety on a hospital unit in the unit structures, medication system design, unit culture, and practitioners' embedded professional accountability for medication safety. Participants made known that they do not view medication safety as a static entity but rather as a complex goal that requires their daily attention and adaptability with every patient. Practitioners developed and followed several processes to achieve medication safety in their practice, they recognized supports for and threats to medication safety, and they made efforts to strengthen medication safety in their practices, structures, culture and systems. This was a major study finding.

Several barriers to medication safety were identified throughout the study, and some barriers gave rise to the development of workarounds to overcome what practitioners viewed as impediments to optimal practice. For instance, medications were often missing at the time they were needed for patients, and practitioners devised system workarounds as on-unit solutions to system barriers that could result in patient harm or AMEs. Workarounds that practitioners designed to accomplish their work or goals done did not correct larger medication system problems that continuously threatened medication safety at the unit level. Participants recognized many links between barriers and the workarounds they devised, and engaged in lively discussions as they envisioned ways to improve

safety on this unit, in their practice area, unit structures and the medication system. Practitioners expressed ongoing doubts as to how much they could influence the direction of system innovations outside adapting their own practice. Another major and encouraging finding in this research was that participants demonstrated their thinking evolved during the research from expressing perceptions of overall powerlessness to effect change to taking charge of several changes on their unit that could make this a safer place for all with medications; I credit the use of the restorative approach in health care research that I used to guide this study with this finding.

In the next chapter, I delve more deeply to explore aspects of findings. Contributions of this study to understanding medication safety in acute care hospitals with nurses and pharmacy workers are discussed, and the implications of these findings for nursing practice, theory, education, and further research are examined in chapter five.

Chapter Five

Interpretation

My purpose with this chapter is to further question and critically interpret findings from practitioner participants' "evocative accounts" (Stringer & Genat, 2004, p. 119) about medication safety. My critique centers around three key, inter-related aspects of these findings which I argue raise a variety of questions about the phenomenon of medication safety in a complex hospital environment and in modern health systems. These linked areas are the phenomena of individual and system workarounds, individual and communal sources of power within the health system I then consider ongoing efforts to make hospital units safer places and offer some recommendations for practice, policy, education, and research. I draw on participants' voices as heard throughout the study in this discussion to close this work, as I reach for further understanding of medication safety on a hospital unit with practitioner participants. This chapter wraps up with my critical reflections about the restorative theoretical approach and possible improvements when using these methods.

Working with Workarounds: Why So Many Workarounds?

I set out to explore medication safety on a hospital unit, and learned that participants held medication safety as one of many goals to achieve in the midst of all other workplace demands in this complex environment. Participants' work on hospital units was constantly buffeted by changing patients' conditions, dynamic happenings and relationships between practice requirements and unit culture, structures, medication system design, and wider health care system

influences. Participants expressed in stories and photos that their overarching goals were to care for assigned patients and complete their work safely. At the same time, a pervasive underlying approach that participants used to achieve medication safety in their daily practice was to work around current processes and systems.

Vogelsmeier et al. (2008) describe the phenomenon of workarounds as first-order problem solving where staff create a mechanism to "work around" a problem without trying to change the underlying cause that created the problem. Halbesleben, Wakefield, and Wakefield (2008) assert that workers manage workflow "by substituting alternative, informally designed, and inconsistently applied work processes" (p. 3). While not disputing that workarounds occur as practitioners attempt to solve problems and barriers in their daily work, Lalley and Malloch (2010) propose a more robust conceptualization of workarounds in health care that focuses on creativity of workarounds as innovative work redesigns. However one defines workarounds, they are widely recognized in the safety literature within and outside of health care, and their prevalence in my study findings required closer scrutiny. Specifically, the number and variety of workarounds associated with medications raised critical questions for me about the implications of workarounds for nurses' work, for medication safety, and for hospital system safety.

Practitioners engaged in individual workarounds. Vestal (2008) contends that in the complex environments of modern health care, "nurses have turned the art of working around obstacles into a way of work life" (p. 8). My

findings supported Vestal's argument, as nurse participants discussed several workarounds devised and used to achieve medication safety in response to environmental conditions and distractions. One such workaround was employed by some nurse participants in their practice, as described earlier, when they documented before medications were administered to patients in this potentially chaotic unit environment:

> *Sometimes I sign after, sometimes before, I'd rather sign when I put it [a pill] in the cup, because the ramifications of someone coming along when I've forgotten to sign it afterwards and giving it twice is worse than the patient refusing it after you sign for it, or spitting it out or whatever, you can fix that by writing refused or vomited or whatever. (Nurse Participant, Focus Group1)*

> *I sign the time and my initials when I pop them in the cup too, because I am doing it right there in the patient's sight. Then I know I have put that one in the cup, and if someone interrupts me then I know … (Nurse Participant, Focus Group 1)*

A current nursing fundamental text outlines standard nursing procedures for medication administration as "the drug administration should be documented immediately after the client has been administered the medications" (Potter et al., 2009, p. 692). One nurse participant stated she signed prior to medication administration to prevent patient harm from inadvertent double dosing; her patient safety goal motivated her to pre-document. Another nurse participant stated she anticipated she would administer medications and she pre-signed to counteract distractions and recall which pills were poured, as a memory aid. Eisenhauer et al. (2007) describe workarounds as "nurses not following standard procedures either

for the benefit of the patient or the convenience of the nurse" (p. 84). This description coincided with these two nurse participants' explanations of their workaround to safely administer medications and manage work processes at the same time in this complex environment.

In a seminal study of nurses' work, Hutchinson (1990) found that nurses were well aware of rules, but engaged in rule bending behavior to prevent harm to patients, and then covered up their actions. Hutchinson described this rule bending behavior by nurses as "responsible subversion" (p. 3). The nurse participants in my study did not hide their actions, but rather openly explained how and why they worked around documentation procedures and freely discussed prematurely penning their initials on a MAR (Medication Administration Record) to signify medications were administered. Nonetheless, their actions fit the template of responsible subversion in other respects. That is, they worked around the existing documentation system procedures to try to improve the safety of medication administration in their demanding work environments.

Furthermore, although nurse participants freely discussed pre-documenting medications, and I observed nurse participants writing on MARs as pills were placed in medication cups, there was no overt communication directing or offering an option to nurses to pre-document medication administration in certain situations, such as a written reminder on MAR binders. This silence of formal written communication about pre-documentation could indicate that nurse participants were not exposing these actions to scrutiny, which could be similar to Hutchinson's assessment that nurses covered up their actions. Moreover, as nurse

participants did not call management's attention to this use of a reverse order for documenting medications, nurse participants could resort to using this workaround when they deemed it necessary. That is, nurses appeared to interpret situations and use their judgment to adapt their practice to work around perceived patient safety risks or work flow problems, which resembles Amalberti et al.'s (2006) assertion that workers deviate from standard work processes when a safety risk or work flow blockage is encountered.

Further questions come to mind about why participants perceived that so many workarounds were necessary, and perhaps expected, in this and other situations, to manage work flow and achieve medication safety. Were workarounds a reflection of a work environment where nurses had to layer additional strategies beyond standard nursing procedures to administer medications safely because they did not believe that they could administer medications safely with standard procedures in the time allocated or with the number of patients or medications they had? What does that say about processes used on this hospital unit, in this system, and taught in nursing education programs? Were there ripple effects on workflow and medication safety from workarounds, and were there points when a workaround was deemed a safety risk? Were there measures in place to monitor and redesign systems where workarounds were not only prevalent but a practice norm? Each of these questions surfaced for me in regard to each workaround that was reviewed.

To open up the discussion of why workarounds were used and deemed necessary in nurse participants' work, current literature was searched for relevant

discussions about workarounds. Safety scientists Amalberti et al. (2006) and Rasmussen (1997) theorize that workers in complex work environments frequently complete procedures in non-linear ways that depart from standard work processes to overcome work or system design deficiencies, following the path that is deemed most useful and productive for efficient work flow at the time. Amalberti and colleagues conceptualize these workarounds as "deviations and violations" (p. i66), theorizing that in health care, "violations can become more frequent and more severe over time so that the whole system 'migrates' to the boundaries of safety until an accident or recalibration occurs" (p. i68). They argue that although workarounds are very often justifiable for individual practitioners as a way to problem solve their work days, workarounds perpetuate system problems and enable poor system design, as workers become so adept at devising informal ways to overcome problems that any urgency on the part of organizational decision makers to correct system deficiencies is thwarted. Furthermore, Amalberti and colleagues theorize that workarounds may be more prevalent than errors in complex systems where multiple, competing formal and informal rules exist. In fact, they argue that workarounds may indicate that workers are actually working very hard to maintain high levels of safety and prevent errors in dynamic, complex adaptive systems (p. i66). Workarounds in health care therefore seem to be both an inevitable part of and a potential vulnerability associated with getting the work done in complex health systems for practitioners.

Given their prevalence and their potential to perpetuate dysfunctional systems, researchers have begun to recognize the need to describe and understand

workarounds in health care. For example, Halbesleben, Savage, Wakefield, and Wakefield (2010) studied and described workarounds used by individual health care workers in four hospitals as "alternative work procedures that bypass a perceived block in work flow" (p. 125). Koppel et al. (2008) developed a typology of workarounds used with bar-coded medication administration (BCMA) processes and found 15 types of workarounds and 31 types of causes of BCMA workarounds in five hospitals over three years. Vogelsmeier et al. (2008) described two types of workarounds associated with the implementation of an electronic health record and eMARs in nursing homes: there were workarounds to combat work blockages associated with the technology, and workarounds to circumvent organizational processes that were not updated to link with new technology (p. 114).

In their concept analysis of workarounds in health care, Lalley and Malloch (2010) assert that nurses sometimes use workarounds in response to workflow blockages, faulty system designs, and unworkable processes in an effort to "simply get the work done" (p. 31). These scholars propose a "descriptive definition of health-care workarounds [as a] creative, redesigned process that facilitates care to patients by providing opportunities for nurses, designers, regulators, and administrators to interact and produce novel patterns or knowledge" (p. 31). What is helpful about this analysis of workarounds as creative work redesigns is that while many authors suggest that workarounds are used to overcome workflow blockages; Lalley and Malloch conceptualized workarounds as more than overcoming barriers, suggesting that workarounds

facilitate patient care and create new knowledge. They further argue that as moments of knowledge creation, workarounds are opportunities for learning about and planning system improvements. The place where Lalley and Mallock's, Vestal's (2008) and my findings converged was in looking at workarounds that are not generally recognized within health care as exemplars of practitioners' knowledge, nor are they usually recognized as opportunities to diagnose system problems and improve. This led me to question: Were workarounds to medication administration procedures recognized? Was anything being done to examine this workaround to determine the need to redesign medication administration processes to make this workaround unnecessary? It seemed the answer was no on both counts.

The workaround of pre-documenting medications was discussed openly by nurse participants and frequently observed on this unit; it appeared that this workaround was acceptable when used within tacit safety boundaries. However, I questioned: What were the safety boundaries, and were there times when this workaround was perceived by nurse participants as a safety risk, and therefore wrong? What was the difference or was there a difference between pre-documenting as a workaround and pre-documenting as a safety violation? According to one participant, nurses clearly saw there was a difference between pre-documenting as a workaround and pre-documenting as a violation. The example provided of pre-documentation as a violation involved a medication safety risk that was uncovered when medications were checked, as described by one nurse participant in this excerpt from an earlier quote:

We had an instance last year when a new nurse failed to give five IV antibiotic doses during one shift, some were signed for, some weren't, and because of the fact that they [IV meds] are delivered for twenty four hours, it was clear to us that these medications hadn't been given. (Nurse Participant, Focus Group 7)

The nurse's behavior described migrated beyond safety boundaries for acceptable practice, as medications were not administered, which placed patients' safety and nurse's employment on this unit at risk. This behavior was sanctioned as unacceptable and therefore corrected on this unit. This situation could be compared to Kirke's (2010) ethnographic account of officers' responses to rule bending and breaking in the British army. Kirke described that the difference between the "OK-ness or not OK-ness" (p. 370) of a behavior that was a deviation from standard operating procedures in the army was often assessed by officers in authority who considered the circumstances and consequences of the deviation.

In my study, other than the example of the nurse who missed administering several doses of antibiotics, no stories were shared of team members exerting power on the unit to halt nurses from pre-documenting medications administered to improve medication safety. I theorized that this well known workaround was a practice nurse participants chose to use when they had to decide if they could manage perceived work flow problems by pre-documenting and then administering medications, or if they could manage to administer all patients' medications according to standard nursing procedures in a scheduled time, considering what else was occurring on their team or unit. Added to the mix,

nurses in this unit culture expected their colleagues to check and administer scheduled medications that were not signed for if these were noticed. Therefore it seemed that strictly following a fundamental nursing procedure was not usual practice for many nurse participants, as long as medications were administered.

From a restorative point of view, this pre-documenting workaround could be viewed as an example of how nurse community members used their local knowledge to try to make their unit, where they had identified many hazards to medication safety, as safe a place as possible for themselves, each other, and for patients. However, the safety risk with workarounds generally, including pre-documenting medication administration, was the lack of discussion and scrutiny that was afforded to them, as well as the failure to take current workarounds into account when new system features were designed or system changes introduced. Nurse participants within this community could collaborate to investigate this workaround within this practice community, study the actual prevalence of this workaround in context, and determine if there were actual costs associated with this workaround over time in terms of adverse medication events, lost time, or lost opportunities for the system to improve or maintain system integrity. In the future, nurses could re-evaluate this workaround in a deliberate way to see if it remained safe over time as other system changes occurred, such as the introduction of technology requiring nurses to document administration of bar-coded medications to patients. The safety risk with workarounds generally, including pre-documenting medication administration, was the lack of discussion and scrutiny

that was afforded to them, as well as the failure to take current workarounds into account when new system features were designed or system changes introduced.

It was also apparent during my research that the use of individual workarounds was not restricted to nurses. Physicians also engaged in workarounds that could influence medication safety on this unit, hospital, and health care system. For instance, some physicians worked around medication reconciliation guidelines by ordering medications for patients on previously completed medication history forms, or PIPs. As discussed in the previous chapter, this physician workaround was a medication safety risk for patients. To avoid the safety risk of undetected or missed medication orders written for patients, which was an issue when physicians wrote medication orders on a PIP after the patients' transfer to this unit, a nurse participant explained that she intervened by offering physicians a list of the medications a patient had told her he or she takes. In this way, the nurse directed physicians' attention away from writing medication orders on already processed PIPs:

> *… with some doctors, I don't just give them the PIP for a patient that we get transferred here, I just put the meds that the patient tells me that they were taking on our ask list and tell the doctor the patient told me they were taking these meds, and the doctor can decide. (Nurse Participant, Focus Group 5)*

Chevalier and colleagues (2006) noted that medication orders written on PIPs for admitted patients were frequently missed, which was a known safety risk associated with medication reconciliation systems. This situation therefore seems to be emblematic of nurses' efforts to use their knowledge to advance safe care

for their patients, as described by Eisenhauer et al. (2007), and Vestal (2008), by recognizing that a workaround frequently used by physician colleagues presented medication safety risks for their patients. However, this workaround also speaks to power issues within the healthcare context in a few important ways. Firstly, while this physician workaround was described as one which both contravened organizational guidelines and could negatively impact medication safety for their patients, the nurse participant described that she used covert, diversionary maneuvers rather than directly approaching physicians as colleagues and team members to problem solve this safety issue. Secondly, although nurse and pharmacist participants reported that they had concerns about and recognized the inherent system design problems related to the medication reconciliation processes, these practitioners had little opportunity to contribute to medication reconciliation guidelines through a democratic process at the organizational level. This was a glass ceiling effect where participants clearly saw system design deficiencies with PIPs, but did not feel they could reach up to move hierarchical levers to correct deficiencies or patch faults in the medication reconciliation system.

Participants' perceived inability to do anything about system design resulted in participants devising and trying out creative approaches to protect patients from possible harm from missed medication orders on PIPs. There were obvious safety risks associated with nurse participants' efforts to divert physicians from writing orders on previously reviewed PIPs. For instance, if physicians were diverted from viewing as well as writing orders on patients' PIPs, medication

discrepancies on PIPs could be missed by physicians. An associated ripple effect and possible health care system safety risk with this workaround was that nurse-physician working relationships could be damaged if physicians perceived that nurses were trying to manipulate a source of patient information available about their patients, even if it was to prevent physicians from writing medication orders on a patient's previously completed PIP.

I questioned if measures were in place to monitor the frequency of physicians' medication ordering practices on previously reviewed PIPs in this hospital, and if orders written on PIPs after patients' admissions were often missed, and how often those lapses presented a safety risk as Unroe and colleagues (2010) describe. I also wondered if any other nurses on this or other hospital units tried to divert physicians from using this workaround, and how physicians and other nurses viewed this workaround, and if there had been efforts to change the medication reconciliation procedures to prevent this workaround. I also pondered if the upcoming electronic health record and physician computer order entry could include built-in boundaries to prevent physicians from entering medication orders on a PIP after it was reviewed for the first time. There did not seem to be any organized effort to stop this workaround, nor to assess whether this physician workaround was acceptable to others in the wider health care community, which made me wonder how those who implemented the medication reconciliation system in this hospital and province were monitoring how it was working out for those using it.

From a restorative point of view, this diversionary tactic could be viewed as an example of how a nurse participant used her local knowledge of medication reconciliation guidelines to try to make this unit safer for patients, her colleagues, and for physicians with medication orders. However, manipulating the physician to bypass the problematic PIPs instead of openly discussing the issue jeopardizes trust between professionals, making it a potentially costly strategy. If instead, nurses, physicians, pharmacists and managers openly discussed the issues with PIPs together, they could perhaps find an opportunity to collaborate to improve medication safety. This collaborative problem solving exercise could point towards benefits for all if nurses, physicians, pharmacists and managers meet to complete a Medication Safety Self-Assessment® for hospitals, as suggested by ISMP-Canada (2009). Electronic health records may be introduced in this hospital, and current issues with PIPs could potentially be resolved if these workarounds were openly identified and discussed. As Vestal notes (2008), if nurses used what they know about workarounds as power to influence the design of work and workplaces, there could be real benefits for both nurses and patients in their care.

Participants collectively engaged in system workarounds to achieve medication safety. In the case of individual workarounds, participants used their own ingenuity to adapt their individual practice in order to tackle barriers to work flow one at a time. In contrast, the system workarounds which were apparent in my findings were collectively fashioned deviations from system design and processes that entailed not only unit-wide tolerance, but also required inter-

departmental and even, to at least some extent, system-wide acceptance to occur. By system workaround, I mean a deliberate, collectively used approach by a health care community as a whole to circumvent a systemic fault in the overall design and/or policies of a complex health care system. This is in contrast to individual workarounds, where there was little if any deliberate cooperation at the unit, inter-departmental, organizational or system levels to enable, recognize, or even encourage practitioners to deviate from prescribed practice and policy.

A system workaround is supported and perpetuated as a deviation from an established system process; system workarounds are created and sustained by organizational community member practitioners or decision makers as they adapt communal policies and practices to overcome systemic barriers and flaws. System workarounds become embedded as a way for organizational communities to accomplish work practices when obvious shortcomings to system design are encountered, and as system design deficiencies are not addressed by those gatekeepers with organizational authority to monitor and correct system design problems. System workarounds may be ignored or even encouraged by those with organizational authority, as there is little incentive to correct system deficiencies when workarounds work so well as creatively devised solutions that enable workers to overcome system problems. However, it can be argued that at least some system workarounds also signal considerable system dysfunction.

As the previous chapter indicates, practitioners worked around medications delivered and left in the pharmacy drop off box as a system workaround. Nurse participants pointed out that they were often unaware when a medication was

placed in the pharmacy drop off box, and since they were unaware, deliveries of unsecured medications in the box were neglected and could deteriorate or be misplaced. None of the nurse or pharmacy technician participants who shared their views about this system design for medication deliveries to a drop off box claimed ownership of this box or expressed responsibility to pick up medications placed in the box. Rather, participants voiced their concerns about the pharmacy drop off box, such as:

> *There is no communication between the pharmacy tech and the nurse when it [medication] is dropped off, so that is not ideal for security. We don't know it is there, and it could go missing from the box. (Nurse Participant, Photo Walkabout 1)*

> *That [medication drop off box] is just not safe, period. It is out in the open, unsecured. (Pharmacy Technician Participant, Focus Group 6)*

Participants' expressed concerns pointed out serious medication delivery system design safety issues that extend far beyond individual practitioners working around one or two missed medication deliveries. Participants indicated that some practitioners had given up on guessing if and when a medication might be in the box, and some participants resorted to "rework" (Halbesleben et al., 2010, p. 124) by calling pharmacy to resend medication. Pharmacy technician participants raised concerns about medications neglected in drop off boxes, and the questionable safety of unrefrigerated medications for patients; however, they could not generate solutions within their current work context to correct these

medication delivery concerns, and participants continued to work around medications delivered to this box.

In trying to understand the implications of this medication delivery system for staff, patients and the system, it was useful to examine related research. For example, in their study of nurses' work processes in a revamped delivery system that included automated drug distribution cabinets in a Canadian hospital, Balka et al. (2007) found that nurses reported problems with medication drop-offs and poor communication about medications. Balka et al. reported that drug "discrepancy receipts" (p. S54) were printed for but not collected by pharmacy staff, and temperature sensitive medications were delivered to a countertop unbeknownst to nurses, who were supposed to notice their arrival and put these in a unit refrigerator. Balka and colleagues did not indicate whether nurses and pharmacy technicians collaborated to devise solutions to these medication delivery system problems.

In other recent research, Halbesleben et al. (2010) mapped process blocks to nurses' medication administration into three categories: blocked medication order communication, blocked medication order entry into their pharmacy computer system, and blocked or delayed time for medication delivery from pharmacy to a unit. Halbesleben and colleagues reported that individual nurses worked around medication delivery problems and tried to obtain missing medications by overriding automated drug dispensing machines, borrowing medication from another patient, or another unit. Historically, missing medications were identified as an issue with unit dose medication systems (Scott-Cawiezell et al., 2009). For

instance, Saginur et al. (2008) found unit dose medication systems were known nationally to be plagued by missing medications, especially when central pharmacies in hospitals were not open for 24 hours, as was the case for the hospital in this study. In other settings, researchers have also documented nurses borrowed medications from other patient's cassettes (Eisenhauer et al., 2007) or replaced missing medications for patients by borrowing medications from other hospital units (Baker, 1997).

Although the nurse participant quoted earlier pointed out that this drop off box was where medications outside regular deliveries were left in this cart based unit dose medication system, I questioned if there was not a safer, more secure delivery method than unannounced deliveries of medications to a unit drop off box. Since pharmacy hours were restricted to about 12 hours a day, and the job of ensuring medications were retrieved and appropriately stored when delivered to a pharmacy drop off box was not clearly assigned to either pharmacy or the unit staff, it raises questions of whether economics to fund dedicated medication porter positions, recruitment problems, lack of practitioner input, or other organizational issues were the driving force behind administrative decisions about medication delivery in this system design. Given the costs of missed medications, double orders, and potential adverse events for patients from the administration of improperly stored, duplicate deliveries, or late medications, amongst other safety risks, it seemed relevant from a restorative perspective to ask "what are the goals?" with medication delivery – and how can they be best achieved?

As many participants worked around medication deliveries in pharmacy drop off boxes, I posit that neither pharmacy technicians nor nurses felt they had any control or power to achieve medication safety with deliveries in this medication system design, so they developed a system workaround whereby participants disregarded medications in the box, and nurse participants went to their medication bank seeking to obtain missing medications for patients. There was no evident impetus to monitor or redesign delivery of medications to units in this medication system design; therefore, people with organizational authority seemed to tacitly recognize the ineffectiveness of medication delivery to drop off boxes and sanction this system workaround of practitioners ignoring the medications delivered therein. Of even greater concern, however, is the fact that just as one individual workaround often begets another as its effects over time are felt throughout the system, it was clear in my study findings that one poorly functioning system workaround, the pharmacy drop off box, was related to another problematic system supply workaround, the medication stash or bank, which a nurse participant described as "our workaround" (Focus Group 7).

As one pharmacy technician described:

> *They [nurses] don't get that because they work twenty four hours and we don't, we can't always be here to send meds. I don't blame them for wanting meds and they are waiting, that is why they have stashes. We do the same thing with stashes, we have extra of certain stock meds, because we don't want to run out… Like I get it, but it's just the way it is. (Pharmacy Technician Participant, Focus Group 6)*

As this participant explained the rationale for this system workaround, it was pointed out that medication safety was supported when units did not "run out" of needed medications and when missing medications could be replaced from a unit medication bank supply. Accordingly, nurses and pharmacy technicians co-operated to develop and maintain a medication bank to ensure an available on-unit supply of medication, efforts which constituted collective, inter-departmental working around the unit dose medication system. This system workaround was underpinned by provincial and regional funding decisions that influenced when limited hospital pharmacy services were available; decisions which gave tacit license to organizations to work out their own workarounds to manage medication supply deficiencies. This workaround became a banner of unwritten collaborative practice and policy that participants used to circumvent system constraints which interfered with the supply of prescribed medications for patients. Since decision makers knew about system workarounds with pharmacy drop off boxes and medication banks and did not take any steps to curtail them, and since there was no evident plan to correct the system design deficiencies that triggered these workarounds, another opportunity to learn and improve from workarounds was forfeited.

In Amalberti et al.'s (2006) theorizing about deviations and violations in health care systems, deviations are seen to occur in response to competing demands on workers in complex systems. These system workarounds could in fact reflect practitioners' intelligent and flexible response to a system fault as they banded together to make sure that medications were available at the point of care

for patients in hospitals twenty four hours a day as ordered, when needed. If workarounds are a reflection of practitioners' intelligent and flexible responses to system faults, this is consistent with a critical theoretical view of technology where workers are understood to deviate from following technological processes as prescribed when alternate, more democratic and more effective ways of using technology are found (Feenberg, 2010).

When viewed with a restorative lens, the medication bank system workaround highlighted community member participants' adaptive behavior to ensure a store of medications for times of predictable supply challenges when pharmacy was closed. Participants clearly described why this system workaround was necessary for optimal function of this medication system design; it was accepted, and not viewed as a safety violation by participants. In addition, it was clear that both study participants and health system decision makers expected this workaround to exist to compensate for resource allocation decisions, staffing shortages, or other issues that contributed to this system-wide deficiency with medication delivery and supply. From a restorative perspective, however, systemic failure to scrutinize medication bank workarounds was clearly associated with safety risks in pharmacy and on patient units. For example, one safety risk with the bank workaround was that medications were limited to the available number and variety of medications that were left over and banked at a given point in time. Accordingly, a specific medication might not be available at the time it was required, or it might not be located among poorly organized medications in a

bank. Practitioners also encountered increased risk of making a selection error with the minimal organization of medications kept together in the bank.

Of utmost concern, the system-wide acceptance of medication banks to address a medication supply deficiency meant that there was no impetus for system design change to curtail ongoing instances of missing medications and delivery problems. According to the Canadian Society of Hospital Pharmacists (2008) when hospitals adopt a unit-dose medication system "all drugs are compounded and dispensed by Pharmacy in a patient-specific, individually labeled and ready-to-administer form" (p.3). This directive highlights that Canadian hospital pharmacies dispense all medications for individual patients as unit doses from pharmacy as ordered. If this hospital pharmacy was open and dispensed all medications for patients as ordered and made these available at the time the medications were scheduled and needed by patients, there would be no need for practitioners to seek another source of appropriate and available medications to administer to patients. Given the limitations of the unit dose medication system to supply medications from pharmacy to units when needed, and the embedded accountability of practitioners to provide appropriate medications as needed for patients, a medication bank was maintained as an alternative source of unit dose medications to compensate for safety risks from missing medications. One nurse participant voiced her concern that if the location of their medication bank was exposed, it would be taken away. However, it seemed that with the current pharmacy limitations, efforts to detect and confiscate unit medication banks would not support medication safety within the

organization, and both pharmacy technician participants and nurse participants stated they had banks.

On a broader contextual level, another system workaround with profound implications for nurses' abilities to maintain medication safety on the unit in the midst of ongoing distractions, interruptions, and challenging workloads was the frequent use of unit hallway spaces for patient admission when the facility was over-capacity. As one nurse participant voiced:

> *…additional patients are admitted to our unit when we have no available rooms, so these patients are put in beds in a hallway. This gives new meaning to us nursing in the hallways, and how do patients feel? (FO 19)*

As in hospitals across Canada, decision makers in this region respond to pressures to admit patients from an overflowing hospital emergency department. When all patient areas in the hospital are already filled, administrators work around standard admission procedures and send patients to hallway beds on inpatient units. For unit staff, this system workaround was seen as creating conditions of borderline safety for patients in many respects, including concerns about medication safety. This system workaround, which is initiated by a hospital bed-allocation manager, does not address a larger system issue of a recurrent insufficiency of available beds for admitted emergency department patients, an insufficiency which is in turn related to a range of deficits in community care. Since unit hallway admissions temporarily ease patient flow issues in emergency, and since emergency department overflows and waiting times have become "hot button" issues in the media for politicians and senior health care administrators (see Scissons, 2010), it is reasonable to question whether the primary outcome of

unit hallway admissions is safer care – or less adverse media coverage of emergency departments? For example, safety risks for unit hallway patients included no guaranteed access to standard hospital safeguards such as oxygen, vacuum, nurse-call systems, dedicated places for medications or belongings, washrooms, or privacy. Another risk to placing patients in unit hallways, besides the obvious fire safety restrictions, was that additional patients and their medications were added to a nurses' assignment to be accommodated wherever possible, a consequence that diminished nursing care time for every patient on this unit.

Walsh, Cortex, and Bhakta (2008) found 54.9% of admitted patients in emergency departments stated they would prefer to wait for an inpatient hospital bed in a hallway bed on an inpatient unit rather than a bed in an emergency department hallway; on the flip side, 45.1% of admitted emergency patients preferred to wait in emergency hallways as they valued quick access to a doctor. Paparella (2010) described medication safety risks for patients "boarded" (p. 347) in hallway beds after admission from emergency departments. Safety risks were linked to poorly communicated medication orders and missed medications for patients boarded in temporary locations, lost and misplaced patients' medications and belongings, and situations when patients could be overlooked even though they were in plain sight in unit hallways. However, since no studies have yet been conducted that compare patient outcomes (medication-related only, or all outcomes) between admitted emergency patients and unit hallway admitted patients, we truly cannot say much about the nature of medication safety for

patients in hallways. What is arguable is that this deviation from a system norm of placing patients in bona fide hospital bed-spaces occurred frequently and set an example for unit nurses that management regularly worked around system norms as it struggled to keep up with health care needs, perhaps while edging from complexity towards chaos. As Amalberti et al. (2006) describes, this state of edging towards organizational chaos occurs as there is more and more widespread acceptance of violations:

> … these violations can become more frequent and more severe over time so that the whole "system" migrates to the boundaries of safety until an accident or a recalibration occurs which forces a realignment....otherwise this leads to rules and regulations being progressively ignored, and eventually greatly increase the possibility of disaster as the organization becomes accustomed to operating at the margins of safety. (p. i68)

If viewed as a deviation that demonstrates system migration towards chaos, boarding patients in unit hallway beds raises questions about the necessity and acceptability of this system workaround within the health care system. Yet, it seemed this system workaround was necessary; it was used extensively and nurse participants adjusted their work to accommodate additional patients. Participants did not discuss instances where patients boarded in hallway beds experienced adverse medication events, or how medication safety was monitored for patients in hallway beds. This suggests there is a strong need to assess barriers to medication safety for patients in hallways beds, and if caring for patients in hallway beds on this unit or any unit influences medication safety adversely for those patients, or for other unit patients or practitioners. However, it is not clear

how the hospital or wider health region monitors this system workaround, nor is it clear if there are imminent plans to ease patient flow pressures by redesigning or expanding patient care capacity, perhaps to an unoccupied floor in this hospital, or easing patient influx with better access to primary care. Furthermore, nurse participants did not indicate that they were informed about safety boundaries with this system workaround, such as if there was an upper limit for the number of patients that could be placed in unit hallways or in emergency department hallways at one time. Information of this nature would be good to know, as it would indicate if decision makers had a silent agenda regarding patient safety thresholds on inpatient units, which they were currently using as a pressure relief valve for patients in emergency department hallways. It was not apparent that there was a move to stop this system workaround, as it was viewed as a way that hospital decision makers adapted to accommodate overcapacity patients admitted through emergency.

Findings in this study suggest that workarounds are a frequent occurrence at the individual and system level to overcome barriers associated with standard work or system processes in terms of medication system design. However, workarounds such as physicians' orders on PIPs and unit hallway admissions also validate what safety experts argue, which is that for better or worse, sometimes bringing improvements to patient safety and sometimes with the opposite effect, workarounds in health care are a way of life. Patient safety is almost certainly compromised if standard processes are used in certain situations, but conversely, significant safety risks also accompany many workarounds at least some of the

time. My study findings indicate that participants adapted to these challenging conditions by constantly using their knowledge and critical thinking to anticipate the consequences of working around standard ways and to choose what would be a safest way to provide patient care within each contextualized patient circumstance.

What was also clear in my findings, however, was that just as others argue (Lalley & Malloch, 2010; Vestal, 2008), participants and decision makers used their own expert, informal and/or formal sources of power to create and adapt knowledge to develop individual and system workarounds. This may help to explain why the safety implications of common medication-related workarounds were openly explored in the research, as there was an overall sense that individual and system workarounds were accepted and in many cases expected of practitioners as they used their knowledge in novel and creative ways to achieve their patient care goals in this health care system. That is, using their knowledge to create and use workarounds seemed like the only exercise of power that most participants viewed as possible for them at the outset of this study. However, the findings also indicate that as participants used the restorative research methods to look at their workplace together, a collective sense of power to critically question and reconsider what could be done about medication safety began to emerge. As this communal power to question became visible amongst unit nurses, it became equally clear that questioning power relations within the organization and within the system was required to understand the complexities of medication safety in this environment.

Power Shaped Medication Safety

It was clear from my study findings that nurse participants frequently exercised informal power to engage in creative workarounds in their own practice, and to divert physicians from engaging in a medication order writing work around. Nurse and pharmacy technician participants and decision makers as members of this health care community acted to work around systemic flaws in their practice environment. There were links between the prevalence of workarounds and power structures at the individual, team, organizational and even regional levels of the health system within which this hospital unit functioned. Examples were the tacit inter-departmental and administrative acceptance of practitioners' neglect of medications delivered to a pharmacy drop off box, nurses' use of medication banks on a hospital unit, and pharmacy technicians' stashes kept to adapt to supply shortages of medications which could be linked to restricted pharmacy hours. These examples illustrated that in the face of resource constraints even senior health system leaders did not exercise authority to prevent employees from working around the system and developing workarounds. In fact, health system leaders used both medication system and other system workarounds, such as unit hallway admissions to address emergency department overcapacity situations. It therefore seems that a deeper exploration of sources and uses of power within health care is required to better understand the complexity of achieving medication safety within the study unit, or any health care setting.

In discussing the use of formal or informal power in hospital systems, Canadian nurse researchers Faulkner and Laschinger (2008) assert: "Formal power stems from workplace positions that are visible and essential to achieving organizational goals and informal power evolves from peer relationships and alliances in the organization that facilitate organizational goal accomplishment"(p. 215). In this publicly funded regional hospital, people at each level of the organizational hierarchy used formal power vested in their position to accomplish work goals, including work to support or sustain medication safety. For instance, regional hospital administrators used formal power to implement unit structures and this medication system, and to procure medication equipment based on provincial purchasing contracts. Administrators used formal authority to compose and post formal organizational policies, procedures, and processes to work within organizational structures and to regulate and direct employees to accomplish organizational goals by setting job descriptions and staffing guidelines.

Nurse, pharmacist, and pharmacy technician participants espoused medication safety as a work goal in this complex hospital, and yet, members of each discipline had slightly different goals related to their area of expertise. Participants in this study did not suggest they wanted to assume control of medication safety or system design; however, participants expressed that improvements to medication system design would make their work more effective and improve medication safety. Nurse participants' medication safety goals reflected their embedded accountability to ensure that each of their assigned patients received correct medications safely. Pharmacist participants' medication

safety goals were to assess, communicate about, and enter medication orders into a pharmacy computer system. Pharmacy technician participants' goals were to prepare medications according to guidelines and distribute ordered medications to patient units. Participants worked with health system resources such as structures, processes, procedures, technology and equipment, and information resources, and with practice community members in similar positions to achieve work goals.

Individuals and groups of practitioners demonstrated that there were times when they did and times when they did not feel that they had power, and did or did not exercise power, to enhance medication safety in ways that met their respective goals. At the beginning of my study, for instance, participating nurses expressed sentiments that they had limited power to make change on their unit or in their medication system. As the study progressed, participants seemed somewhat surprised to learn that they did have considerable power in some important areas to improve safety in their system, as they democratically decided to organize and rearrange medications and supplies to provide safer access for all, and to clean up medication carts and their medication room.

When nurse participants began to look at their unit structures and equipment in terms of medication safety, they identified unit hallways as a pivotal place where nurses felt both empowered and disempowered at the same time. In terms of empowering their practice, nurses expressed that it helped them to work in the hallways close to assigned patients. Paradoxically, though, the proximity to patients which hallway work afforded also meant that nurses were constantly subjected to hallway activities over which they had no control:

> *We are nursing in the hallways. I don't mean that nurses shouldn't be close to their patients, we should be, but we are so prone to interruptions in the hallway, .. we are out in the open. (Nurse Participant, Focus Group 5)*

I questioned why nurses were working in the hallways; what was happening here? A nurse participant told me that in the past, nurses used informal power to have hallway stations placed near to assigned patients (Field Observation 11). I wondered if nurses a decade ago might not have anticipated the amount of hallway traffic, interruptions, and potential threats to maintaining medication safety that occur now in unit hallways. Nurses used informal power to reduce their own hallway travel time by situating medication information and supplies at hallway stations, although hallway traffic was not limited to nurses seeking supplies. As mentioned in the previous chapter, hallway traffic included people travelling to and from patient rooms, delivering and picking up patients on stretchers, supplies, linen, laundry, garbage, and drugs as hallways were public travel spaces, with hallway nurses' stations as stopovers.

It appeared, from field observations, that nurses adapted their practice to nurse from hallway stations. There was no visible concerted effort to limit distractions and interruptions to nurses working at hallway stations, such as a "do not disturb" sign, which meant each nurse had to deal with the complexities of medication safety associated with their hallway work location on their own. Yet, several researchers report that interruptions and distractions are the most frequent organizational causes of medication errors for nurses (see Agymang, & While, 2010; Bennett et al., 2010; Biron et al., 2009; Conrad et al., 2010). Nonetheless,

no participants questioned or suggested ways to improve medication safety for nurses working at hallway work stations in this system. Thus, while reorganizing supplies and cleaning up medication carts at hallway stations are important safety initiatives of their own, they do not address systemic problems of ongoing hallway traffic and distractions to nurses who are out there working in hallways.

There was also a distinct difference between "nursing in the hallways" at medication carts as a way to work closely with patients and the "hallway nursing" which resulted from admitted patients lying in hallway beds due to a shortage of staffed patient rooms. The latter phenomenon of hallway nursing was in fact an ongoing source of disruption to nurses' work that jeopardized medication safety, whereas the former practice of nursing in the hallways was at least in part originally devised by nurses themselves to work effectively within the constraints of their surroundings and resources, including staffing resources. The issue with both forms of nursing practice, however, is that nurses did not seem to perceive that they could exert any significant power to change the circumstances in the hallway under which they currently worked.

> *We have certain equipment and nurses work with what they have. (Nurse Participant, Focus Group 5)*

I questioned what this nurse participant's statement could mean in terms of medication safety. Here she asserted that she and other unit nurses, as members of a practice community, could only exercise their expert power to work with the tools and equipment provided. However, while nurses were expected to and expected themselves to work with and learn to trouble shoot malfunctioning

equipment; they were not routinely afforded the privilege of previewing equipment, or invited to cast a vote for equipment features that would best match their medication management needs before equipment was acquired. Furthermore, even though nurses are the primary users of equipment such as medication carts and infusion pumps, participants did not indicate that equipment suppliers provided training sessions on how to trouble shoot or fix malfunctioning equipment. Yet, they needed to learn to operate and trouble shoot the equipment to ensure that patients received medications as ordered, including at times when equipment malfunctioned and there was no technical support available. Nurse participants therefore used informal power to share information and equipment fix-tips with each other about how to correct problems with malfunctioning medication equipment. This power to work with equipment and share experiential knowledge with colleagues could enhance medication safety, such as when nurse participants discussed how to detect and unplug blocked medication tubing (Nurse Participants, Focus Group 2). Wolf (2007) and Tucker, Singer, Hayes, & Falwell (2008) noted that nurses share stories about how to fix problems with equipment with other nurses to support safe medication practice and to help colleagues on their unit learn from their mistakes.

In using the research to voice their concerns about lack of input into the medication system design, nurse participants asserted that they wanted to have functioning equipment such as pumps readily available, and did not want to have to search for "wandering" equipment borrowed by people from other units (Nurse Participant, Photo Walkabout 1). However, there were also issues with equipment

that “stayed still”. For example, medication carts, which were necessary equipment “props” for the unit dose medication system (Nurse Manager Participant, Focus Group 7), were not borrowed by other units, but different styles of carts dictated different layouts of supplies on carts in different locations, which nurse participants identified as a medication safety barrier. These system issues also illustrated the nurse manager’s limited power to obtain equipment with capital funds, although she stated that while she hoped to order two new carts to replace two existing carts, she could not ensure that the five medication carts were standardized.

The lack of standardized or functioning medication equipment, and the wandering equipment, which could be due to scarcity of functioning pumps, or too few pumps for the growing number of patients on this and other units, illustrates the unanticipated consequences of introducing medication administration technologies without fully considering the implications for increased demand for equipment, ongoing costs (maintenance, adequate supply), staff time, or expectations on staff to “find a way” to implement every medication order whether there was a medication or pump available or not. Some of these concerns are detailed by Balka et al. (2007) in their discussion of the challenges encountered by practitioners in one Canadian hospital when drug dispensing machines were placed on units. Balka and colleagues asserted that “the balance of power in the patient safety equation lies in the work context and implementation issues, and not just the technology” (p. s48). Similarly, Tucker and Edmondson (2003) found in their study of organizational and psychological dynamics in

hospitals that nurses devised and used remedies to adapt to "shortcomings in materials and supplies without bothering managers" (p.69). Nurse participants in my study indicated that they devised and used their skills to fix and reset deficient equipment, secure a sufficient number of IV pumps for their patients' needs, and unplug blocked IV tubing to achieve medication safety.

While it is easy to understand how numerous deficiencies with equipment and systems impact nurses' work and medication safety, in my study site as in other hospitals, the power to choose and purchase medication equipment was mostly exercised by people further up the organizational hierarchy, with little input from the nurses and other employees who used the products purchased. This could explain the resigned tone of the nurse participant who expressed that "we have certain equipment" (Nurse Participant, Focus Group 5). These nurse participants were not included in discussions to select pumps that would meet needs for medication infusions, nor were they able to ensure that sufficient numbers of pumps were provided to meet the needs of the acutely ill patients in their care. This chasm between those who purchase and those who use health care equipment demonstrates a systemic power fault line between administrators and care providers that can affect medication safety. Yet, several experts argue that hospital medication equipment could be used more effectively if users such as nurses had input into equipment purchasing decisions (see Lau, Vargo, & Gieras, 2008; Tucker et al., 2008; Wolf, 2007).

On a more reassuring note, it was clearly evident that all of the study participants exercised their own individual expert power to "check all the time"

(Nurse Participant, Focus Group 2). Nurses checked that medications were appropriate for their assigned patients, pharmacy technicians checked accuracy of medication cassette filling and recorded this on a paper posted on a pillar in their department (Pharmacy Technician Participant, Photo Walkabout 3). Pharmacists checked that correct medications were ordered for patients and entered orders into the pharmacy computer system (Pharmacist Participant, Focus Group 3). All participants stated they checked medication labels, and checked their own and their co-workers' work to ensure that correct medications were ordered, prepared, dispatched, or administered to support medication safety. Elder et al. (2008) found nurses working in an intensive care unit identified that checking medications and labels, IV solution bags, and recalculating dosages were common nurses' routines to ensure medication safety (p. 27). Checking was also how practitioners identified missing medication, located and addressed near misses before these happened, and discovered medication errors after they occurred. In addition, the nurse manager participant spoke of checking medication error reports and discussing these with staff, and pharmacist participants mentioned retrieving medication alerts from ISMP-Canada online.

As earlier findings indicate, participants also checked the physical security of medications (e.g. counting narcotics kept in locked narcotic cupboards), checked that equipment was available and functioning, and checked patients' charts for medication orders and re-orders. These findings align with other reports of nurses being primarily accountable to check medications, detect medication safety risks and inconsistencies, to prevent patient harm in the "medication

management process" (Faye et al., 2010, p. 376), and communicate medication information to other nurses and health care providers (see Eisenhauer et al., 2007; Joy, 2009; Manias et al., 2005; O'Connell, Crawford, Tull, & Gaskin, 2007). However, these expectations for checking raise the question: which types and amounts of checking can be reasonably vested in individual practitioners, and which types need to be incorporated into the overall system checks by design? For example, while pharmacists in the study site checked in electronically to access a secure password protected pharmacy order entry system, electronic safeguards to enhance medication safety in real time for other practitioners' work were not identified, and there were few medication administration technologies to support nurses' work on the unit. Similarly, the way some medications and equipment were secured and others were not, and the conditions under which medications were prepared by nurses as opposed to pharmacists, were manifestations of power relations in this medication system and within the larger health system, which point out what was valued. For instance, narcotics and controlled medications are scrupulously counted and locked up by nurses and pharmacy technicians as required by law, and yet, nurses prepared narcotics and other high risk medications, which were not provided as unit doses, for patients at unsecured medication carts while standing in busy unit hallways, as this participant states:

> *Nurses have to mix several high alert medications and they take the risk every time of making an error with a potentially lethal drug. (Nurse Participant, Field Observation 15)*

These differences in power over one's practice or autonomy were also visible by geographical location. For example, pharmacy technician participants mixed and prepared medications under strictly controlled conditions sequestered in a dedicated pharmacy department to ensure medication security, a provision to safeguard medication integrity that seemed to vanish at the point where nurses prepared medications for patients in hallways. Conditions at hallway work stations could precipitate risks for compromised medication safety with contaminated cart preparation surfaces, or compromised security due to medication theft or loss, as medication safety and security was protected by nurses who were often multitasking. These examples invited deeper questions to probe why this unit dose medication system was designed to provide some but not all medications in unit dose form for patients. I pondered why high risk medications for patients were not prepared under the safest conditions possible in this medication system, and why security was maintained for some medications, and not all? Was there an economic rationale for preparing unit doses of high cost or high volume antibiotics in pharmacy rather than preparing unit doses of relatively cheap, but highly lethal narcotics, anticoagulants, and insulin preparations? While some authors assert unit dose medication systems reduce medication errors made by nurses (Oishi, 2009; Potter et al., 2009; Saginur et al., 2008), it is not clear whether those unit dose medication systems that were evaluated and associated with fewer medication errors by Oishi, Potter et al., and Saginur et al., were ones where all medications were supplied as unit doses, rather than a system like this one that featured a mixture of unit doses, multiple doses, and missing doses.

The limits to power over one's practice also played out from shift to shift as patients were admitted or discharged on each bay in a constant cycle, health care practitioners worked their shifts, had days off, and worked on different bays on their next shifts. Specifically, the context on each bay changed as patients and practitioners changed. For example, nurse participants pointed out that each bay had a differently configured medication cart with dissimilar medications located in different places, and therefore participants associated medication safety risks with ever changing assignments, patients, and medication cart contents. How did nurse participants manage their ever changing patient assignments and uphold medication safety? During observations, I noticed two salient strategies: nurses checked their own and each others' work in process, and somehow, individual nurses attended to many activities at the same time as they administered medications. It appeared that nurse participants focused attention on tasks at hand while maintaining awareness of happenings in their environment, and adapted their medication practices to the space where they worked in unit hallways. Ebright (2010) posited that nurses engage in cognitive processes such as "thinking ahead and acting proactively, strategic delegation, use of hand-written notes for remembering and tracking care…continuously organizing, re-prioritizing and making decisions for the management of work flow and care delivery" (para. 12). While the nurses in my study did indeed seem to engage in stacking, the other findings suggest that this strategy was not always sufficient to ensure medication safety in such a complex and often chaotic environment.

To recap, it was evident that participants in this study used formal power associated with organizational guidelines and informal expert power to create and use local knowledge in their own practice to try to attain their medication safety goals. Often, they exercised this power individually or collectively in the form of creative workarounds that signaled a significantly dysfunctional health system, both in terms of overall concerns such as patient flow and in terms of medication safety issues. The pervasiveness of individual and system workarounds suggests that staff and management both perceived themselves as having little ability to overcome power differentials within the organization or the system to suggest or implement safer ways for the health system to function. Yet, as my study progressed, practitioner participants worked together to generate and implement some improvements to make their workplace a safer place in which to give and receive care.

Linking Findings with Recommendations: Can We Make Hospitals Safer Places?

Given the links between knowledge, power, system complexity and workarounds that were evident in my study findings, what recommendations can be generated? I consider these issues together to provide specific directions for practice, policy, education and future research.

Implications for practice. In a recent effort to address the challenges of working within today's complex health systems, the Canadian Patient Safety Institute (CPSI) collaborated with all of the health professions to produce an interdisciplinary resource for students and practitioners across the health sciences entitled *The Safety Competencies – Enhancing Patient Safety across the Health*

Professions (Frank & Brien, 2008). This document outlines six patient safety competency domains for all health professionals, with elements of knowledge, skills, and attitudes to accompany each domain. The participants in my research confirmed what the CPSI is saying: that complex health care systems and hospital environments present a variety of opportunities and challenges for practitioners seeking to provide safe patient care and services. Complex environments call for a strong foundation of safety competencies to tackle the everyday barriers to providing safe care.

An important finding in this research was participants' emerging recognition that they possessed shared power to effect changes that could make their unit a safer place for everyone with medications. Participants went beyond their usual work practices to study and strengthen medication safety within their complex technological systems and environment using innovative approaches to improve their practice. As their participation in the study progressed over time, participants' thinking evolved from a focus on working to complete their immediate work, such as "nurses work with what they have" (Nurse Participant, Focus Group 5), to anticipating risks and making changes to improve safety. This finding illustrates how practitioners participated in an "enabling competency" to "recognize clinical situations that may be unsafe and support the empowerment of all staff to resolve unsafe situations" (Frank & Brien, 2008, p. 6), a safety competency developed by the Canadian Patient Safety Institute for health care professionals.

My recommendation for practice is that practitioners' potential to exercise communal power should not be confined to this single study, nor overshadowed by other health care initiatives. The restorative participatory photo methods clearly drew practitioners into my research and invited them to recognize and begin to use their collective power to make some changes. There is a need to examine further how these kinds of methods engage practitioners so that principles of participatory, practitioner-led inquiry can be translated into other efforts to improve care, whether that is the formation of practitioner-led medication safety teams, practitioner-led tracking and assessment of workarounds, or practitioner-led monitoring and evaluation of system improvements. My point is, the way that participants responded to taking part in this research can help us understand how to support practitioners and managers and health care teams to recognize and use what they know to support the way that they deliver care.

A related recommendation to supporting practitioner-led initiatives is that practitioners from a variety of health care disciplines in a hospital or health care organization need regular forums where they can openly discuss safety risks and barriers with health care decision makers in their work area, places where ideas and suggestions for safety improvements for patients and practitioners can be raised and democratically debated in ongoing meetings. Furthermore, to ensure more democratic design of equipment and related care technologies, forums are also needed where health care practitioners could meet with equipment service experts regarding challenges with malfunctioning equipment. This

recommendation is meant to support practitioners to contribute to a culture of patient safety in forums where they can advocate for safety improvements in their health care units and complex adaptive systems, where many strengths and vulnerabilities co-exist and influence their practice, such as practice space and workplace design, equipment and, technology. This recommendation coheres with the first patient safety competency described by Canadian scholars and co-chairs Frank & Brien (2008).

In terms of both individual and system workarounds, it is critical to begin more systematic, practitioner-led recognition and study of these phenomena at the point of care. I therefore recommend that practitioners here and in other hospitals collaborate with managers and clinical educators to monitor the types, safety, and prevalence of individual and system workarounds. These findings can be discussed with hospital decision makers through information-sharing forums to identify implications for safe practice and brainstorm potential improvements to patient care. It could be informative to learn if decision makers overtly support workarounds as an expected means to accomplish the goals of the organization, or if decision makers do not want to know about these work processes. It seems likely that without system redesign, the number or types of workarounds associated with medication administration and system design will continue, and therefore, I recommend an evaluation of the safety and risks associated with workarounds, and implications of workarounds as these exist for patients, practitioners, and the health care system. This evaluation will contribute

knowledge about "quality, professional practice environments" (Canadian Nurses Association, 2009, p.4), and support patient safety.

In terms of teamwork, it is interesting that nurse participants expressed that they valued communicating with patients and other practitioners to ensure that medications ordered and dispensed were correct. This illustrates how practitioners were striving to "meaningfully engage patients as the central participants in their health care teams" (Frank & Brien, 2008, p. 10), another core safety competency that has been identified for Canadian health professionals. Nurse participants indicated a printable discharge medication list for each patient could improve medication safety for patients being discharged at the hospital unit level; this observation is consistent with Bates (2007) directive that "Consultation on medications should be available to patients at key points in the medication use process, e.g. when a patient is admitted and discharged and receives medication at a pharmacy" (p. S4). The implication for nursing practice from this finding was that nurse participants could meet as team members with physicians, pharmacists and information technology specialists to find ways to devise and print a discharge medication list, perhaps linked to each patient's MAR, a copy of which could be transmitted to a patient's community pharmacist, which CPSI puts forth as a key team safety competency (Frank & Brien, p. 10).

In addition, nurse participants voiced their chagrin with the cumbersome documentation requirements, especially when nurses were required to hand sign for narcotics and controlled drugs in five areas. Accordingly, I recommend that practitioners and managers meet and discuss ways to improve efficiency of all

medication documentation, including narcotics and controlled drugs. Electronic documentation programs that nurses could use may be available, but the region may be waiting for a comprehensive electronic health record to be implemented. If so, discussions about documentation innovations may be limited, but they should occur anyway, to inform the design and evaluation of the health information technology that is selected and support effective communication and documentation procedures for practitioners, as outlined by Frank & Brien (2008).

Practitioners in my study also sought to learn and adapt their practice to stay current and to generate and share knowledge with colleagues and patients to support safe care, an attitude that is described as an essential foundation for a patient safety culture (Frank & Brien, 2008). The nurse manager participant stated she acquired and maintained current resources to support nurses' practice and learning in this environment. A nurse educator and a pharmacist participant pointed out medication safety resources available online that practitioners could access on the unit, for instance the ISMP-Canada Medication Safety bulletins where information about medication occurrences reported to the Canadian Medication Incident Reporting and Prevention System (CMIRPS) is available. An implication for health care leaders who are committed to support learning and development of knowledge in practice is to ensure that practitioners have access to and information about how to locate resources for learning in their practice environment. I recommend that practitioners participate in identifying and selecting learning resources and supplies that are essential to support their current work and strengthen safety in healthcare environments.

During this study, nurse participants shared information and stories about medication errors and near misses informally to help each other become aware of and avoid risks and barriers to medication safety in their work environment and to work together and figure out ways to avoid these barriers in future. The power of stories to promote knowledge exchange is recognized in business (Denning, 2006), health care ethics (Charon & Montello, 2002) health services research (CHSRF, 2007), and health care risk management (Brown, 2010). This on-unit collaborative assessment and response was a meaningful, productive way for practitioners to re-story and to propose solutions to avoid on-unit medication safety risks for themselves and others in the future. I therefore recommend that managers, practitioners and clinical educators explore ways to use story-telling to recognize and discuss medication safety risks with colleagues in care environments, as one strategy to "maintain and enhance patient safety practices through ongoing learning" and "exchange feedback with colleagues on safety issues on an ongoing basis in an open manner" (Frank & Brien, 2008, p. 6). This story-telling unit-based activity could also be used to learn about and assess practitioners' understanding of new medications or combinations of medications.

Implications for health care systems and policy. At the health system level, the knowledge and policy that are generated to support medication safety have profound implications for our collective power to improve the places where we provide health care. The WHO and Canadian Nurses' Association (CNA) offer patient safety position statements and safety guidelines for health care system leaders about ways to support and improve patient safety. Health system

policy makers need to keep abreast of recommendations and resources available from international and national patient safety leaders, and consider how to collaborate with practitioners and patients to set up and implement programs to move patient safety forward. For example, the WHO committed to 39 "key deliverables" (2009, p. 68) for patient safety globally in their 2008-2009 patient safety program, including a strong recommendation to include patients in all decisions about their care. I recommend health system leaders in this health region collaborate with practitioners and patients to support patients' inclusion in all decisions about their care, which could include patients' perspectives on medication safety with a discharge medication list for patients about to leave hospital.

At the time of writing this dissertation, CPSI and ISMP-C offered several medication safety guidelines although I could not find an ISMP Canada Safety Bulletin about workarounds in hospitals. I recommend hospital decision makers and practitioners continue to check and review safety bulletins to access timely and pertinent information about medications and medication administration technology; however, action must not be limited to checking. I recommend that health system leaders convene meetings with practitioners and patients as indicated, to discuss the nature, prevalence, and impact of workarounds, what these mean to patients, practitioners, and health system leaders, the safety risks that are associated with these, and what workarounds communicate about our health care system overall (e.g. boarding patients in hallway beds). As the patient safety position statement of the CNA directs, "ensuring the provision of safe,

compassionate, competent and ethical care to patients within the health-care system is a responsibility shared by all health care professionals, health care organizations, and governments, and requires involvement of the public" (2009, p.1). I recommend that health system policy makers continue to refer to professional organizations' patient safety position statements, to gain and share knowledge with professionals, decision makers and government leaders, but also to take action to correct safety risks for patients. Health care policy must be shaped concurrently by patient and medication safety publications and by health care system demands, such as the need for hospital beds on staffed and established units when emergency departments are overflowing.

Locally, a health region policy requires employees to report incidents such as medication errors and near misses on occurrence reports, and indicates that information gathered from occurrence reports could be used to improve processes and systems. The intent of this policy for reporting medication occurrences is consistent with Reason's (2004) assessment that information about "active failures and latent conditions" (p. ii29) contributes to improvement in medication processes and systems. Nurse participants (Focus Group 2) stated they did not rely on error reports to stimulate medication system or process improvements which would need to be made by health care decision makers. This finding is consistent with findings of Baker (1997), Chiang & Pepper (2006), Elder et al. (2008), and Kellogg & Havens (2006) and could indicate that in this setting there was little information provided about improvements to medication systems or processes resulting from error reports. These nurse participants indicated that practitioners

viewed medication safety culture on their unit as tangible and relevant to their work, but that a health region safety culture was not as visible, as there were no overt indications that improvements to medication processes and systems occurred based on medication error reports. This suggests that there was a way to go before conditions are in place to encourage all health care professionals to "report the occurrence of an adverse event or close call [and] participate in timely event analysis, reflective practice and planning for the prevention of recurrence" (Frank & Brien, 2008, p. 26).

A recommendation from this finding is that health region decision-makers share information with practitioners about medication safety improvements made to systems and processes that stemmed from reported medication errors; this information exchange could be seen as visibly linking error reports to safety improvements to prevent further similar errors. Health region senior administrators should continue to gather and share information about medication process and system improvements through electronic or written communication (ISMP-Canada, 2009) and "executive walk rounds" (Ranji, & Shojania, 2008, p. 285) where health care executives meet with practitioners at the point of care to discuss safety. These strategies could link unit culture more clearly to the health region safety culture regarding sharing knowledge about medication errors, near misses, and organizational efforts to support medication safety.

Another policy recommendation relates to the amount and currency of policies used to support medication safety. Based on focus group participants' references to a policy about occurrence reporting, and based on photo walkabout

discussions of electronic and paper based resources and policies on this unit, it was clear that there were a range of health region policies that pertained to medication administration. However, given the widespread nature of individual and system workarounds, I recommend that medication-related policies be reviewed regularly by a team of practitioners, educators and managers to ensure that organizational medication policies are consistent with medication procedures as they are actually performed, and to ensure that health organization policies are consistent with new procedures or technology as implemented, as Bates (2007) and Vogelsmeier et al. (2008) described.

Other forums for developing and exchanging knowledge about safety at the point of care include a variety of formal and informal communications between nurses and physicians, patients, and pharmacists. For example, the nurse manager offers a regular forum by going on patient rounds with nurses where nursing care and medications were frequently discussed (Field Observation, 13). In addition, the creation of formal interdisciplinary medication rounds were proposed by a pharmacist participant (Focus Group 3) to establish a place where a physician, clinical pharmacists, nurses, and patients could meet together to discuss medication information. Equally important, pharmacy technician participants discussed spending very limited time on hospital units, and were not observed exchanging information with nurses, patients, or pharmacists. Yet, pharmacy technician participants detailed medication refrigeration requirements in Focus Group Six, and this type of medication information could be very beneficial if it and other updates were shared with practitioners in the wider hospital community.

Perhaps medication storage information could also be communicated to patients with medication prescriptions on discharge. Health care decision makers could meet with practitioners and patients and collaborate to find the most user friendly way to communicate pertinent information to those who need that information.

Several scholars and researchers, and patient safety experts asserted that people must actively connect with each other and the places they share to understand and achieve lasting improvements in health care systems (Frank & Brien, 2008; Marck, in press; 2006; Nemeth, Cook, & Wears, 2007; Wears, 2003; 2008; WHO, 2008). However, deciding which kinds of forums are most important with what team members opens up dialogue on who is included in a practice community, and who tends to get excluded. Complex interactions occurred between and among people in this hospital unit community, which can be viewed as a place shared by patients seeking and practitioners providing health care and treatment. Each person whose work or health care needs brought them to stay and interact on this unit for a period of time was seen as a member of the unit community, and as such could potentially benefit from working together to make the unit a safer place for medications. It seemed then that duration of stay on a unit influenced who is or is not seen as members of this unit community. Pharmacy technician participants whisked in and out of hospital units delivering medications daily; they did not stay and interact on the unit, and consequently, pharmacy technicians were not identified as, nor did they identify themselves as, members of the unit community. Patients placed in hallway beds were also considered transient, and as such, these patients could be marginalized as non-

community members who were temporarily passing through this unit, possibly having their medications administered from a belongings bag during this stopover. Yet, nurse participants recognized that to achieve medication safety, they wanted to build on community safety strengths, which included sharing information about medication errors that happened in their practice to develop medication knowledge, and continuing to seek and share medication resources from within and outside the unit. One instance of recognizing patients as part of their community was shared by this nurse participant, who discussed working together with patients about their medications to make this a safer place for nurses and patients:

> *We try to get the 'BPMH' [best possible medication history] with each patient….This verifies sometimes that 'I know you know best about your drugs, and we would like to work together here' (Nurse Participant, Focus Group 2)*

Frank and Brien (2008) and MacDonald (2010) argue that practitioners must include patients in medication administration and safety processes. Nurse participants in my study demonstrated that they included patients in reviewing and reconciling medications and took medication carts to patients' doorways to prepare medications in the patients' sights. While these collaborations between nurse participants and patients about medication administration are encouraging, I recommend an expansion of medication administration knowledge exchanges between nurses and patients, and pharmacists and patients in hospitals to improve medication safety beyond those which are currently happening. This recommendation is in line with recent movements within the safety field to

enhance patient involvement in health care safety. For instance, the WHO supports "Patients for Patients' Safety Goals" that include "patient engagement…across all areas of patient safety and health care" (2008, p. 30) and the Canadian Health Services Research Foundation (2010) has sponsored forums, projects and research to engage patients in designing health care services in Canada. Vincent and Coulter (2002) assert that patients have and must continue to have a key role in ensuring patient safety, and practitioners working in health care organizations must improve communication with patients as "facilitating active partnerships should be central to any patient safety strategy" (p. 79). Leape and colleagues (2009) argue that health care must be transformed to include patients in every encounter in order to achieve patient safety, and this must be achieved by "consumer engagement – 'nothing about me without me'" (p. 426).

Patient engagement in health care safety will be a challenge on several fronts, as nurse participants in my study discussed asking and giving medication information to patients at the time of gaining a BPMH, but had really not established a process to engage patients in safety initiatives on a regular basis, perhaps due to power imbalances between physicians, nurses, pharmacists and patients in a hospital context. However, I would challenge health care professionals and organizations to work with their communities to determine and develop policies to engage patients and families in medication safety initiatives to improve knowledge exchange and medication safety for patients and families across the continuum of care.

Implications for education. Nurse researchers and scholars advocate for increased attention to and awareness of patient safety in nursing education programs (Frank & Brien, 2008; Gregory et al., 2009). This recommendation fits with what practitioners and decision makers in my study articulated, which is that learning and exchanging knowledge about medication errors, near misses, and safety strategies amongst themselves and between the disciplines was important to them. This counsel is also consistent with the recommendation for inter-professional education made by the CPSI's Canadian Safety Competency Steering Committee, which as mentioned earlier, recently developed and published the first set of inter-professional safety competencies for all Canadian health care students and professionals (Frank & Brien, 2008). These competencies, which address interdisciplinary knowledge about safety culture, teamwork, communication, human and environmental factors, managing safety risks, and recognizing and disclosing adverse events, should be integrated into the core curriculum of all undergraduate health sciences programs to provide a foundation from which specific safety issues can be more fully explored.

Interdisciplinary education sessions about medications and medication safety on hospital units can be both formal and informal. They could be as simple as an online forum for sharing knowledge about medications and medication processes between physicians, pharmacists, pharmacy technicians, and nurses, or as formal as interdisciplinary education sessions about medications, medication processes, and equipment. Practitioners learning together about medications,

processes, equipment, and medication practice intersections and overlaps could improve communication and understanding about medication safety.

Given the finding that threats to medication safety are associated with the way electronic medication histories (PIPs) could be used to re-order medications for patients and the need for printed discharge medication lists for patients, I recommend collaborative education sessions where health care students, managers, practitioners, and patients learn more about patients' medication histories in general, and how discharge medication lists are used elsewhere in the hospital, region, province or country. Health care educators could include patients and families in these discussions as quality improvement initiatives to share information and to find feasible, user-friendly alternatives.

The checking behaviors and workarounds that participants used and discussed during the research also have implications for students in pharmacy, medical and nursing education programs. First, general patient safety competencies as well as medication-specific safety competencies should be included in the substantive content of pharmacist, pharmacy technician, medical and nurse education programs, and second, pharmacist, pharmacy technician, nursing and medical students should have the opportunity to learn together firsthand about the complex hospital systems, processes, and practices that shape medication safety in supervised clinical and classroom experiences during their educational programs. I also recommend interdisciplinary education sessions facilitated by experts in each discipline for students to have opportunities to participate in discussions about medication safety, and sit for clinical

examinations about medications that come from these education sessions. These education sessions could also include opportunities for students to discuss medication safety risks and supports that they encounter on units, for instance in post clinical conferences, reflective journals, and classes.

The prevalence of workarounds also raises issues for how nursing fundamentals texts such as Potter et al. (2009) detail nursing procedures as linear steps for nurses to administer medications, and omit a discussion of overall medication safety in health care. We know that nurse participants in my study and others do not always follow steps to administer medications in a standard linear fashion as described, and we also know that student nurses witness nurses on a unit deviating from the procedures outlined in their nursing textbooks and question these discrepancies between academia and practice. In view of that, I recommend that student nurses be encouraged to discuss deviations from standard medication administration processes that they witness with student nurse colleagues and their clinical instructors. Another incongruity that student nurses might see on hospital units is nurses working around standard medication system design, and students should have the opportunity to discuss the safety of system workarounds with other students and their clinical instructors.

Implications for research. A bias toward practice-driven inquiry was embedded in the design of this study as practitioner community members from nursing and pharmacy participated to generate new knowledge about this phenomenon. Given the active and sustained contributions of my clinical partners in this study, I think that the use of participatory, practitioner-led approaches to

study a range of safety topics in health care with interdisciplinary clinical teams could advance our knowledge of safety in several areas. I also recommend including patients as participants, and seeking participants from a variety of health care disciplines as community members to collaborate in a variety of methods.

In particular, this study demonstrates the need for further exploration of a wide variety of individual and system workarounds. The workarounds that became evident during my research often differed from Hutchison's (1990) view of nurses' rule bending behavior, as explicit rules did not always prohibit the activities that practitioners devised as workarounds. Furthermore, nurses were not alone in workarounds, and it was clear that all team members and decision makers worked around problematic issues in system design. Amalberti et al.'s (2006) description of deviations and violations as practitioners' complex actions based on clinical judgment as "a necessary adaptation" to cope with "conflicting demands of complex work situations" (Amalberti et al., p. i67), most closely explains the workarounds seen here, as practitioners and decision makers adapted their practice to work around competing requirements in a complex health care environment. However, the creative knowledge generation and translation that Vestal (2008) and Lalley and Malloch (2010) discuss in relation to workarounds also needs further illumination in future studies. If we re-conceptualize workarounds at the individual and organizational levels of health systems as creative moments of knowledge-in-action, as these nurse scholars suggest, then we need to understand how that knowledge is created, and how this largely invisible and often essential work of practitioners can best be used to improve

care. Further study is therefore also necessary to ascertain whether some workarounds are safer than others, and if care outcomes with some workarounds are actually safer for patients than if practitioners did not engage in those particular workarounds.

My findings also suggest that further research is needed to explore workarounds with decision makers and practitioners in different contexts, with a particular focus on practitioners' work flow blockages, medication reconciliation workarounds, and how practitioners respond to missing medications in unit dose and bar-coded medication systems. Future studies in other contexts may uncover barriers to medication safety rooted in other medication system designs or flawed structures that were not apparent in these findings, and participants in other contexts may generate solutions to address barriers that are applicable elsewhere. Research could contribute to our understanding of relationships between scripted processes and work practices used to bridge work flow gaps at the point of care.

Study findings also demonstrated the need to study the environmental context of medication safety more closely. For example, participants discussed the threat of interruptions and distractions as they administered medications. Further research is indicated to understand how practitioners respond to interruptions and distractions throughout the medication administration process. This research may uncover heretofore unrecognized approaches that practitioners could use to remain positioned close to patients and work safely while subject to interruptions. For similar reasons, further research is needed to understand the implications of

hallway nursing for patients, nurses, and the system, both in overcrowded emergency departments and hospital units.

I also question if additional analyses of my study findings with different theoretical lenses might potentially extend our knowledge and understanding of medication safety in contemporary health systems. For example, power is the crux of Bourdieu's (1990; 1998) social science theory of practice: how people use power and capital in social settings or fields, and how social structures influence practice, relationships, and social interactions. Nurse scholars Rischel, Larsen, and Jackson (2007) and Rhynas (2005) employed Bourdieu's theory of practice to re-explore and present another view of their findings which suggest that nurses' practice is influenced by structures, situations, and other agents, within the field of care. I could engage in additional analysis of my study findings about how nurses view and use power in dealing with safety issues in their practice, using Bourdieu's theory of practice. A second potential theoretical lens for further analysis of my findings might be found with social scientist, Giddens (1984), who theorized that humans use power to engage in social activities, reflect upon, rationalize, and monitor their actions. Giddens links power in systems and organizations in his "structuration theory" (Giddens, p.1). Giddens posits that actors (humans) use agency (power) in relation to social structures, time and space, resources and rules. Nurse scholars Hardcastle, Usher, and Holmes (2005) suggest Giddens' structuration theory could be used to understand how people produce and use power in their practice to shape systems, and Xiao (2010) applied Giddens' structuration theory to evaluate a nursing education policy in China.

Given my findings about participants' initially expressed inability to change aspects of their work environment, it might be useful to apply Giddens' thinking to look at nurses' use of structural and social resources, and further explore how nurses view and abide by formal and informal rules emanating from authority and structures in a health care organization.

Since the restorative perspective that I used in my research is shaped by Feenberg's original work on philosophy of technology (Feenberg, 1991; Feenberg & Hannay, 1995), a third option for conducting theoretically informed additional analysis of my data could be to use Feenberg's current theory of "democratic rationalization of technology" (2010, p. 26), which incorporates much of his earlier thinking but also represents how his ideas have evolved. Specifically, Feenberg posits that workers question how technological devices are used and modify technology in their practice; he also suggests technology must be linked to workers' reasoning and experience for work to be effectively executed in organizations. This theory could be useful for additional analysis of practitioners' work with technology, particularly because technology design and selection were not seen as democratic processes by my study participants. Furthermore, while Marck used Feenberg's earlier works to interpret her doctoral study findings on technology and nurses' work in acute care (Marck, 2000a; 2000b) and to shape the restorative thinking that I used in my present research (Marck et al., 2008; Marck et al., 2006a; Marck, 2005), I did not find any publications where nurse scholars critique Feenberg's current theory of democratic rationalization or use this theoretical lens to evaluate their findings. This suggests there are several

opportunities to extend knowledge with further analyses of various aspects of my study data.

Critical Reflections on the Restorative Research Approach

The interrelated elements in the restorative approach to health care research (Marck, 2006; Marck et al., 2006a; 2006b; 2006c) provided me with a useful initial framework to explore medication safety with practitioner participants on a hospital unit. The foundational principles of place ethic, citizen science, engaged practice, and adaptive learning and growth informed my methodological choices and enabled me to select appropriate methods to answer my research questions. Nonetheless, in reflecting on my own research experience, I offer two suggestions to expand the restorative perspective on health research which I believe are consistent with its intentions of fostering participatory inquiry and ongoing systems change. Each of these recommendations for an expanded framework for restorative research is discussed in turn below.

Firstly, I suggest expanding the scope of the element of adaptive learning and growth to include an emphasis on mentoring interested research participants to learn to lead future cycles of research with this framework. Some practitioner participants expressed an interest in engaging in future research projects on this unit as this study closed, and I regret that I did not mentor participants in the methods throughout my study so that they would be prepared to embark on future cycles of inquiry with appropriate support and consultation. Such mentoring is key to building capacity for sustainable system change in my view, and should be explicitly incorporated into future research designs wherever feasible.

Secondly, I think that a restorative approach to health care research needs to include an additional, explicit element related to knowledge translation and integrated governance which guides researchers and their clinical partners to work together on optimizing organizational and system uptake of meaningful findings. This could include the deliberate planning at the outset of studies for targeted friendly discussion forums between research participants and organizational policy makers. As a study draws to a close, and research participants have envisioned what could improve safety in their community, a friendly forum could be a place where participants can share information about their engagement in the research, initiate conversations about system safety supports and barriers, and put forth their ideas about needed system repairs or restorations. It could also educate administrators, board members, and other policy makers about the complexity of medication safety at the "sharp end", as research on the introduction of medication technologies has demonstrated (Husch et al., 2005, p. 80; Wulff et al., in press). Including this element of exchanging knowledge for integrated governance in the restorative framework would actively encourage researchers to plan with partners and participants how they can use findings to discuss system safety strengths and gaps with people who have formal power to design and implement system adjustments.

I also recognize as I reflect on the methods I chose to answer my research questions that there are aspects which I would refine in future research. For example, I recognize the limitations of my data in that I confined my sample to nursing and pharmacy professionals, and did not sample patients' and physicians'

perspectives on medication safety, which could have enhanced my understanding of this phenomenon. There would be merit to including physicians' and patients' voices and perspectives in similar future research.

In terms of gathering data in audio recorded focus groups and photo walkabouts, I could have provided participants with pens and paper to write down any important points that they did not want to share in the group discussion about medication safety but wanted to bring to my attention. This may have assisted participants to engage in further discussions and ensured that they each shared what was important to them about the topic. It would also be helpful in future focus groups to have a research assistant to record notes about the focus group dynamics and assist with process mapping. This would have enabled me as the researcher to conduct my photo elicitation focus groups in a more manageable fashion. In future walkabouts, I would also encourage at least one volunteer participant to collect their own set of photos with a second digital camera, as this supports mentoring participants to become comfortable with these methods for future cycles of research.

My last suggestion to improve data collection methods became apparent as my study closed. I regret that I did not include an opportunity to co-create repeat photographs with participants of areas that they chose to clean up and improve during the study. Before and after area photographs could offer visual evidence to participants of the differences that they made to their environment, as they engaged in research to study and strengthen safety with the restorative approach.

Conclusion

This study enabled me to explore medication safety with practitioners and decision makers and learn with these practice community members about supports for and barriers to medication safety on a complex hospital unit. The findings were discussed and shared with participants throughout this study, and contribute to our understanding of medication safety on a hospital unit, and to our understanding of the merits and limits of a restorative approach to health care safety research. Building on existing knowledge and resources, including cultural resources, the participatory practitioner led inquiry and methods empowered participants to actively collaborate to discuss and envision what could improve medication safety on their unit as their home place and collectively move forward to implement some improvements within their purview. Communal power was realized in the form of creating shared capacity to adapt and change to promote medication safety and prevent medication mishaps for each other as community members.

In future work, I intend to further a program of research in health care safety using the restorative approach in different settings with different participants. I would also like to include patients in future studies to learn about their experiences with and priorities for medication safety, in hospital and after discharge. Finally, I want to explore the wider context of medication safety for patients and practitioners by exploring hallway nursing from patient and practitioner perspectives in terms of interruptions and distractions to health care practitioners, patient and provider experiences, and outcomes of care.

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Appendix A.

Medication Safety

Participant Information Sheet - Focus Group

Title of Research Study: Exploring Medication Safety with a Restorative Approach (**Medication Safety**)

Principal Investigator: Elizabeth Domm

Co-Principal Investigators & Thesis Co-Supervisors: Dr. Patricia Marck and Dr. Marion Allen, Faculty of Nursing, University of Alberta

Background: Medication safety is freedom from harm from medications. To achieve medication safety in hospitals, health care workers use their knowledge of patients and medications, and about hospital systems, structures, and processes to check, deliver and administer medications safely. Research to explore and understand medication safety in hospitals is needed to understand the supports for and threats to medication safety in today's practice environments.

Purpose: The purpose of this research is to explore medication safety on an acute care hospital unit with practitioners and decision makers. As a person who works as a decision maker or practitioner, and who checks, delivers, and/or administers medications to patients, you are invited to participate in a research study to explore medication safety on this unit. The main research question is "what are the supports for and threats to ensuring medication safety on an acute care hospital unit?" As a participant, you are invited to discuss with other participants (like you) areas of safety and areas of risk to medication safety on this unit in two focus groups.

Procedures: Participating in focus groups of this study will involve your participation in one or two group sessions on this unit about medication safety with approximately six other participants from the same department. These sessions will last about one hour and be tape recorded by the researcher. You may take part in these research activities and others as you choose.

Possible Benefits: Possible benefits of your participation in this study are that you may share your knowledge with and learn from fellow practitioners about areas on your unit which support or are barriers to medication safety. You may share knowledge or learn about systems, structures and processes that affect medication safety here. In the second set of group sessions participants will view photographs taken on the unit and discuss themes about medication safety with other participants. This discussion may result in new knowledge about ways to improve medication safety on this unit.

Possible Risks: It is not expected that you will suffer any risks from participating in this study. Employment will not be jeopardized by withdrawal or non-participation in this study. Participants who do not agree with all the research findings may be disappointed in the results of the research.

Confidentiality: Participants on this unit are known each other, so it is not possible to remain anonymous from others in the group sessions. You will be

aware of each other's participation in the research if you take part in group sessions.

Any information sharing is voluntary and no participant will be penalized in any way if he or she refrains from speaking in the group discussions. Do not feel you must disclose anything you do not want to discuss. Participants are asked to avoid sharing any information from group sessions outside of the groups. Group discussions will be held in a private meeting room.

Information gathered in the course of the research will be kept in confidence by the researcher except if an exceptional circumstance comes up where professional codes of ethics or the law requires reporting. For example, the researcher would be obliged to report intentional illegal or unethical acts that caused a person to suffer harm. If an exceptional event like this arises, the researcher would first discuss it with the person(s) who provides this information and encourage that person to report the situation.

The researcher will do everything possible to ensure confidentiality of data by keeping it in locked cupboards in a locked office. Any identifying information, including people's names, will be removed from data, and when any direct quotes are used, the identity of the person who is quoted will be masked. Themes from the data will be presented to participants in the second group sessions. In writing the analysis and results from the study, themes and direct quotes will be used. Only the researcher and her supervisors will have access to the raw data. There is no anticipated secondary analysis of the data. Should it be desirable to include any of the research data in future research projects, no such access to the data will occur without prior review and approval of the relevant research ethics boards.

Voluntary Participation: Your participation in this study is completely voluntary. Participating in this study has no bearing on your employment. You may withdraw your consent to participate, and leave the group session at any time during data collection without penalty. If you do choose to withdraw, any data derived from your participation until your withdrawal will be incorporated into the data in this study.

Contact Names and Telephone Numbers:

If you have any questions or concerns about your rights in this study, you may contact the Health Review Ethics Board Panel B representative at the University of Alberta at (780) 492-0302, or please contact any of the individuals identified below if you have any questions or concerns:

Elizabeth Domm RN, PhD Candidate (306) 789-3565 (24 hours)
Dr. Patricia Marck, Associate Professor (780) 492-2109
Dr. Marion Allen, Professor (780) 492-6411
Dr. Christine Newburn-Cook (Call Collect) 0-780 492-6764
Associate Dean, Research
*Nursing Research Office, University of Alberta
(*this office has no affiliation with the study)

Medication Safety

Participant Information Sheet - Photo Walkabout

Title of Research Study: Exploring Medication Safety with a Restorative Approach (**Medication Safety**)

Principal Investigator: Elizabeth Domm

Co-Principal Investigators & Thesis Co-Supervisors: Dr. Patricia Marck and Dr. Marion Allen, Faculty of Nursing, University of Alberta

Background: Medication safety is freedom from harm from medications. To achieve medication safety in hospitals, health care workers use their knowledge about patients and medications, and about hospital systems and processes to check, deliver and administer medications safely. Research to explore and understand medication safety in hospital systems and processes is needed to understand the supports for and threats to medication safety in today's practice environments.

Purpose: The purpose of this research is to explore medication safety on one acute care hospital unit with practitioners and decision makers. As a person who works as a decision maker or a practitioner, and who checks, delivers, and/or administers medications to patients, you are invited to participate in this research study to explore medication safety. The main research question is "what are the supports for and threats to ensuring medication safety on an acute care hospital unit?" As participants like you identify areas of safety and areas of risk to medication safety, a forum will be provided to discuss these systems or processes associated with medication safety on this unit.

Procedures: Participating in this phase of the study will involve your participation in a photo narration session, where participants like you (health care workers) on this unit direct the researcher to photograph areas important to medication safety and describe the significance of the area photographed to medication safety. Practitioner's descriptions will be tape recorded, and each photo narration session may last approximately one hour. You may take part in this or other research activities as you choose.

Possible Benefits: Possible benefits of your participation in this study are that you may share your knowledge with and learn from others about areas on your unit which support or are barriers to medication safety. You may share knowledge or learn about systems, processes, or structures that affect medication safety here. In the second focus group sessions, participants will view photographs taken on the unit and discuss themes about medication safety with other participants. It is possible that you and your co-workers will develop new knowledge about ways to improve medication safety on this unit.

Possible Risks: It is not expected that you will suffer any risks from participating in this study. Employment will not be jeopardized by withdrawal or non-participation in this study. Participants who do not agree with all the research findings may be disappointed in the results of the research.

Confidentiality: Participants on this unit are known each other, so it is not possible to remain anonymous from others in the same group. As you take part in the unit walkabouts, you may be observed and/or overheard by co-workers, and you will be aware of each other's participation. Any information sharing is voluntary and no participant will be penalized in any way if they refrain from speaking. Do not feel you must disclose anything you do not want to discuss. Participants are asked to avoid sharing any information from photo narration sessions outside the groups that they participate in.

Information gathered in the course of the research will be kept in confidence by the researcher except if an exceptional circumstance arises where professional codes of ethics or the law requires reporting. If the researcher is provided with information that is imminently harmful to patients or other people during a photo narration session, the researcher will intervene to safeguard the person(s) in danger. As a registered nurse, the researcher is obliged to report verified information about an unethical or illegal situation presented in the course of the research. If such a situation arises, the researcher will first encourage the individual(s) concerned to report the situation as guided by our respective professional ethical and legal responsibilities.

The researcher will do everything possible to ensure confidentiality of data by keeping it in locked cupboards in a locked office. Any identifying information, including people's names, will be removed from data during transcription, and when any direct quotes are used, the identity of the person who is quoted will be masked. Themes from the data will be presented to participants in the second focus group sessions. In writing the analysis and results from the study, themes and direct quotes will be used. Only the researcher and her supervisors will have access to the raw data.

Voluntary Participation: Your participation is completely voluntary. Participating in this study has no bearing on your employment. You may withdraw your consent to participate from the photo narration walkabouts at any time without penalty. If you do choose to withdraw, any data derived from your participation until your withdrawal will be retained as data in this study.

Contact Names and Telephone Numbers:

If you have any questions or concerns about your rights in this study, you may contact the Health Review Ethics Board Panel B representative at the University of Alberta at (780) 492-0302; or please contact any of the individuals identified below if you have any questions or concerns:

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