

**Information Sharing by Nurses in Intensive Care Units With and Without
Interdisciplinary Rounds**

by

Lynne James

BSc., University of Alberta, 1994

MSc., University of Alberta, 1998

BSN., University of British Columbia Okanagan, 2006

A Thesis Submitted in Partial Fulfillment for the Requirements of the Degrees of

Master of Nursing

and

Master of Science

in the

School of Nursing

and the

School of Health Information Sciences

© Lynne James

University of Victoria

All rights reserved. This thesis may not be reproduced in whole or in part,
by photocopy or other means, without the permission of the author.

**Information Sharing by Nurses in Intensive Care Units With and Without
Interdisciplinary Rounds**

by

Lynne James

BSc., University of Alberta, 1994

MSc., University of Alberta, 1998

BSN., University of British Columbia Okanagan, 2006

Supervisory Committee

Dr. Anne Bruce, Co-supervisor
School of Nursing

Dr. Francis Lau, Co-supervisor
School of Health Information Science

Abstract

Information Sharing by Nurses in Intensive Care Units With and Without Interdisciplinary Rounds

Situation awareness and distributed situation awareness are important concepts in critical care, where large interdisciplinary teams must coordinate their activities through information sharing to provide lifesaving treatment to patients. Little is known, however, about how nurses contribute to distributed situation awareness in different types of intensive care settings. The purpose of this study was to explore information sharing by nurses in two intensive care units, with and without interdisciplinary rounds. The method of rapid qualitative inquiry was used, which emphasizes data triangulation and iterative data analysis. In each of two intensive care units studied, four RNs were observed for eight hours each, and the content and characteristics of information sharing were recorded. This was followed by chart reviews to determine the impact of information sharing by nurses on patient care. The results demonstrated that there was little difference in the type of information shared, the pattern of information sharing by nurses in the two units, and the impact that information sharing had on patient care. An important exception, however, was that nurses in the unit without interdisciplinary rounds contacted physicians twice as often as nurses in the unit with interdisciplinary rounds. The results were integrated into a revised model of distributed situation awareness.

Table of Contents

Supervisory Committee	ii
Abstract	iii
Table of Contents	iv
List of Figures	viii
List of Tables	ix
Chapter 1 - Introduction.....	1
Background	1
Statement of the Problem	2
Conceptual Framework for the Study	3
Purpose of the Study and Research Questions	4
Organization of the Study	4
Chapter 2 – Literature Review	5
Situation Awareness	5
Team Situation Awareness.....	10
Distributed Situation Awareness	14
Factors influencing distributed situation awareness.....	17
Situation Awareness and Communication in the ICU	21
Chapter 3 - Methods.....	26
Rapid Qualitative Inquiry	26
Insider's perspective.....	29

Multiple data sources.....	29
Iterative data analysis and data collection.....	30
Extensive preparation.....	32
Credibility.....	33
Nursing Research using RQI.....	33
Health Informatics and RQI.....	34
Data Collection.....	35
Data collection goals.....	35
Setting.....	36
Site visit preparation.....	36
Data Analysis.....	39
Data Presentation.....	45
Ethical Considerations.....	46
Chapter 4 - Results.....	48
Study Context.....	48
Physical layout.....	49
Patient population and nursing assignments.....	51
Composition interdisciplinary team.....	52
Physician model of care and composition of rounds.....	52
Sources of information.....	53

Nurse Participants, Patients and ICU on Observation Days	53
Information Unique to Critical Care RNs	55
Changes in patient status.	57
Patient and family care wishes.	58
Plan of care.	58
Information Sharing by RNs	59
People with whom RNs shared information.....	59
How information was exchanged.	62
The Impact of Nurse Information Sharing on Patient Care	66
Corrective response to patient decline.....	66
Coordination of care.	66
Improved decision making by other care providers.	67
Care of patient and family emotional and information needs.	67
Factors that Influence Information Sharing by Nurses	68
Factors that improve information sharing.	68
Factors that impede information sharing by nurses.....	70
Chapter 5 - Discussion	73
Q1 - Information Unique to Nursing.....	74
Q2 - How, Where, Why and With Whom Information Is Shared.....	75
Q2 (a) - How information is shared in ICU.....	76

Q2 (b)- Where information is shared in ICU.....	77
Q3 - The Impact of Nurse Information Sharing on Patient Care	77
Q4 - Factors that Enhance and Hinder Information Sharing by Nurses.....	79
ICU Nurses, ICU Rounds and Distributed Situation Awareness Theory	83
Limitations of the Study	88
Contributions and Recommendations for Research and Practice	89
Conclusions	91
References.....	92
Appendix A: Research Information Sheet	110
Appendix B: Nurse Consent	112
Appendix C: Patient and Family Consent.....	117
Appendix D: Data Collection Form.....	122
Appendix E: Interview Guide	124
Appendix F: Preliminary Analysis for Participant Review	126
Appendix I: Site A ICU Floor Plan	133
Appendix J: Site B ICU Floor Plan	135
Appendix K: Information Sources Used by Critical Care RNs	137
Appendix L: Forms and Pamphlets used by Critical Care RNs.....	142
Appendix M: Information Sharing between Study Nurses and Others in the ICU	144

List of Figures

Figure 2.1: Model of individual situation awareness	8
Figure 2.2: Model of distributed awareness	18
Figure 3.1: Summary of the data collection and analysis process.....	41
Figure 3.2: Spatial zones in the Site B ICU.....	44
Figure 4.1: Patient room	50
Figure 4.2: Nursing workstation	51
Figure 4.3: Mind map illustration of results.....	56
Figure 5.1: Original model of distributed situation awareness	86
Figure 5.2 Revised model of distributed situation awareness.....	87

List of Tables

Table 3.1: Pre-visit site profiles	37
Table 4.1: Characteristics of study sites	48
Table 4.2: Nursing and unit context on observation days	55
Table 4.3: People with whom nurses shared information	62
Table 4.4: Counts of synchronous, asynchronous and linear information sharing	64
Table 4.5: Percentage of time nurses spent sharing information in each ICU 'Zone'.....	66

Chapter 1 - Introduction

Background

The healthcare system can be a dangerous place to receive care. Each year in Canada, approximately one in 18 patients in the Canadian healthcare system, and one in ten patients in acute care experience a patient safety incident (PSI), a preventable, unintended outcome of patient care (RiskAnalytica, 2017). Up to 400 000 people suffer from a PSI, leading to 40 000 annual preventable deaths, and \$2.75 billion in direct treatment costs.

Patient harm in healthcare systems is a global problem. Worldwide, 17% of hospitalizations are affected by PSIs, 30-70% of which are preventable (Slawomirski, Auraaen, & Klazinga, 2017). They are the 14th leading cause of death worldwide, and treatment of PSIs is responsible for 15% of acute care costs (Slawomirski et al., 2017).

Interest in patient safety in healthcare systems was launched by the Institute of Medicine's influential report on patient safety "To Err is Human" (Kohn, Corrigan, & Donaldson, 2000). Today, health care professionals can draw on 20 years of research into the causes of PSIs, and communication failures are repeatedly identified as important causes. According to the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) in the United States, communication failures are the primary root cause in more than 70% of sentinel events, and a contributing factor in more than 85% of patient safety incidents (JCAHO, 2006). As well, in 2008, the Canadian Patient Safety Institute drew on health care professionals and scholars across Canada to identify six Domains of Patient Safety. Domain 3, "Communicate effectively for patient safety" directly addressed the importance of communication in patient safety (Frank & Brien, 2009). And more recently, Lawton and others (2012) conducted a systematic review in which they identified communication failures as contributors to PSIs at every level of the health

care system – from failures of interpersonal communication between health care professionals, to inadequate organization-wide communication systems (Lawton et al., 2012).

One of the primary goals of communication in healthcare teams is to provide a common understanding of the patient's current state and treatment goals (Jones et al., 2018). This improves what is known as situation awareness (SA), so that team members are aware of crucial information regarding patients and families, understand its implications, and can accurately anticipate what will happen to the patient if they do or do not intervene (Cornell, Townsend-Gervis, Vardaman, & Yates, 2014).

Statement of the Problem

In intensive care units (ICUs), patients with life threatening illness or injury receive care from large interdisciplinary teams. Coordination and communication within these teams is important but challenging due to heavy workloads, rapid admission and discharge of patients, and different work schedules. Organizations have implemented strategies to improve communication, including documentation, such as interprofessional plans of care, technology, such as hands-free, voice-activated devices like Vocera, and practices such as huddles and interdisciplinary rounds.

There has been some research to suggest that interdisciplinary rounds may improve patient care and nursing participation in patient care (Artis, Bordley, McGrath, Mohan, & Gold, 2017; Gurses & Xiao, 2006; Le Blanc, Schaufeli, Salanova, Llorens, & Nap, 2010; Ryan, Jackson, Woods, & Usher, 2019; Ten Have et al., 2013). However, there is also research to suggest that rounds do not always encourage nursing participation, and that it is still difficult for nurses to participate in care recommendations and decisions (Artis et al., 2017; Caronia & Saglietti, 2018). There is very little information on how rounds influence information sharing by

nurses, and how that in turn impacts patient care. The central focus of this study is to explore information sharing by critical care nurses in ICUs with and without interdisciplinary rounds.

Conceptual Framework for the Study

Situation awareness theory has been developed and extended since 1995 (Endsley, 1995, 2015; Stanton, 2016; Stanton, Salmon, & Walker, 2015; Salmon, Stanton, Walker, & Jenkins, 2017; Stanton et al., 2006). Situation awareness (SA) refers to the "state of knowing what is going on around you", and is present in individuals and teams (Jones, 2015, p. 98; Salmon et al., 2017). The most popular model of individual SA was presented by Endsley in 1995. In this model, situation awareness progresses through three stages of awareness, understanding, and anticipation, which is followed by a decision and action (Endsley, 1995, 2015). This model has been used as a framework for studies of situation awareness in nursing, though few studies have been conducted in ICU settings (Koch et al., 2013; Korkiakangas, Weldon, Bezemer, & Kneebone; Patterson, Procter, & Toffoli, 2017; Sitterding, Broome, Everett, & Ebright, 2012; Sitterding, Ebright, Broome, Patterson, & Wuchner, 2014; Stomski et al., 2018; Stubbings, Chaboyer, & McMurray, 2012).

A relatively new theory of SA incorporates individual SA into a theory of distributed situation awareness, or DSA (Stanton, 2016; Salmon et al., 2017; Stanton et al., 2017; Stanton et al., 2006). This newer model expands on concepts of individual SA to incorporate individuals, teams and socio-technical systems into its model. Relatively few studies have explored this model in healthcare settings, and to my knowledge, none have examined nursing's contribution to DSA in ICU environments.

Purpose of the Study and Research Questions

The purpose of this study was to explore how information sharing by nurses takes place in ICUs with and without interdisciplinary rounds, and to determine what the impact of information sharing is on patient care. To do this, I studied four key questions, and interpreted them through the lens of DSA theory. The four questions were:

- 1) What patient and family-specific information is generated by, or unique to, nursing in these environments?
- 2) How, where, and why is information shared with other members of the interdisciplinary team?
- 3) What is the impact of nurse information sharing on patient care?
- 4) What factors influence information sharing by nurses?

Organization of the Study

This study follows the traditional thesis format. Chapter 1 provides an introduction and explains the purpose and theoretical framework for the research. Chapter 2 provides a review of current SA literature, moving from a discussion of individual SA, through team SA, and finally distributed SA. Then, I discuss situation awareness in the ICU, particularly with respect to ICU rounds, and proceed to the purpose of this study. In Chapter 3 I describe the rapid qualitative inquiry research method before discussing the research methods used for this study. In Chapter 4, I describe my results in detail. I begin with the study context, and then discuss the results including evidence for unique nursing knowledge, patterns of information sharing, and factors that facilitate and impair information sharing. Finally, Chapter 5 provides a discussion of the results within the context of current research findings, and through the lens of SA theory. I conclude with a brief discussion of study limitations, contributions and recommendations.

Chapter 2 – Literature Review

In this chapter, I review the current literature on SA in healthcare and ICU environments. I begin with a review of the theory and concepts supporting the concept of individual SA. Then, I describe the theory and research behind team and distributed SA. Finally, I discuss SA and interdisciplinary rounds in ICU environments, identify some gaps in current research and describe the purpose of this study.

Situation Awareness

Situation awareness (SA) is a concept that arose in the field of ergonomics that has helped researchers explain how humans perform elaborate tasks in complex and changing environments. SA has been explored extensively in human factors and safety research in the fields of aircraft operation and air traffic control, and it is increasingly being invoked as a framework to guide research in healthcare fields (Abbott, Rogers, & Freeth; Gluyas & Harris, 2016; Green et al., 2017; Stubbings et al., 2012; Taylor, Sims, & Haines, 2014).

While there is no universally accepted definition of SA, scientists generally agree that SA can be described as "knowing what is going on around you", or "having the big picture" (Jones, 2015, p. 98; Stanton et al., 2017). Situation awareness was first described by Endsley in 1995 in the field of military aviation (Endsley, 1995). Situation awareness was described early on by Endsley (1995, p. 36) as "the state of knowing what is going on"; an integrated picture of a practitioner's current situation". It is a mental construct that encompasses the practitioner's goal, and the complex environment from which the practitioner gathers information to achieve their goal (Patterson, Procter, & Toffoli, 2016). To this day, Endsley's (1995) model of situation awareness is the most frequently cited of all models of SA, and this is true in the nursing literature as well as in human factors research (Orique & Despains, 2018; Stanton et al., 2017).

According to Endsley (1995, 2015), SA requires three increasingly sophisticated levels of information integration; awareness, comprehension, and projection. *Awareness* consists of accurately perceiving pertinent information that is available in the environment. Level 1 SA, awareness, does not require a highly detailed mental catalogue of everything that is going on in the environment; rather, it is an abstract representation of information relevant to a person's goals (Stanton et al., 2017). There is evidence that individuals with high levels of SA often foreground related information and filter out much of the detail in the environment (Stanton et al., 2017). Carried to extremes, this filtering out of detail causes people to act based on experience and assumptions, while potentially ignoring important facts. Awareness, therefore, relies on a practitioners' ability to perceive and pay attention to relevant information, and requires a balance of taking in and filtering out information appropriately in a given situation (Endsley, 1995; Stanton et al., 2017).

In the intensive care unit (ICU) setting, nurses obtain their information from a variety of sources. These sources include clinical assessments, electronic and paper medical records, displays on mechanical ventilators, infusion pumps and vital signs monitoring equipment, conversations with colleagues and many others (Koch et al., 2013). It is challenging for nurses to simply be aware of all of the different sources of patient information, let alone their contents, yet this is required to have an adequate understanding of their patients' status, and to achieve Level 1 SA.

Level 2 SA, comprehension, moves beyond awareness to understanding the meaning of the information gathered in Level 1 (Endsley, 1995). Individuals take potentially unrelated types of data and synthesize them in such a way that they have an accurate understanding of what is

happening (Endsley, 1995). Characteristics related to comprehension include education, experiences and memories that are related to the situation (Endsley, 1995).

The information gathered in Level 1 SA can seem overwhelming and disconnected for those who do not understand it. For example, to achieve Level 2 situation awareness, nurses not only observe vital sign recordings and perform clinical assessments; they understand whether or not those recordings are within normal limits. They are aware that the drug norepinephrine is ordered for the patient, understand that norepinephrine elevates blood pressure, and also understand that it has been ordered because the patient is in septic shock. An inexperienced nurse may have the same Level 1 SA as an experienced nurse, but that does not automatically translate to Level 2 SA (Endsley, 1995; Stanton et al., 2017). Level 1 SA is necessary but not sufficient for Level 2 SA.

Level 3 SA, projection, is the integration of information from Levels 1 and 2 in order to anticipate future events (Endsley, 1995; Patterson et al., 2016). Sometimes, this anticipation provokes action toward a goal (Endsley, 1995; Stanton et al., 2017). Building on the previous example, a nurse who is aware of a patient's vital signs and clinical assessment (Level 1), and who understands that the patient is hemodynamically unstable (Level 2), may accurately predict that if the patient was allowed to remain unstable, he could suffer, die, or experience organ damage, and to prevent this from happening the nurse must administer norepinephrine. This is an example of Level 3 SA in which a nurse is aware of the current situation, understands its implications, and has made a reasonable projection about what the current situation means for the future well-being of the patient. To cite Endsley (1995), nurses demonstrate all three levels of SA when they understand their patients in terms of "What are they doing, why are they doing that, and what will they do next" (p. 38). Figure 2.1 provides an illustration of individual SA.

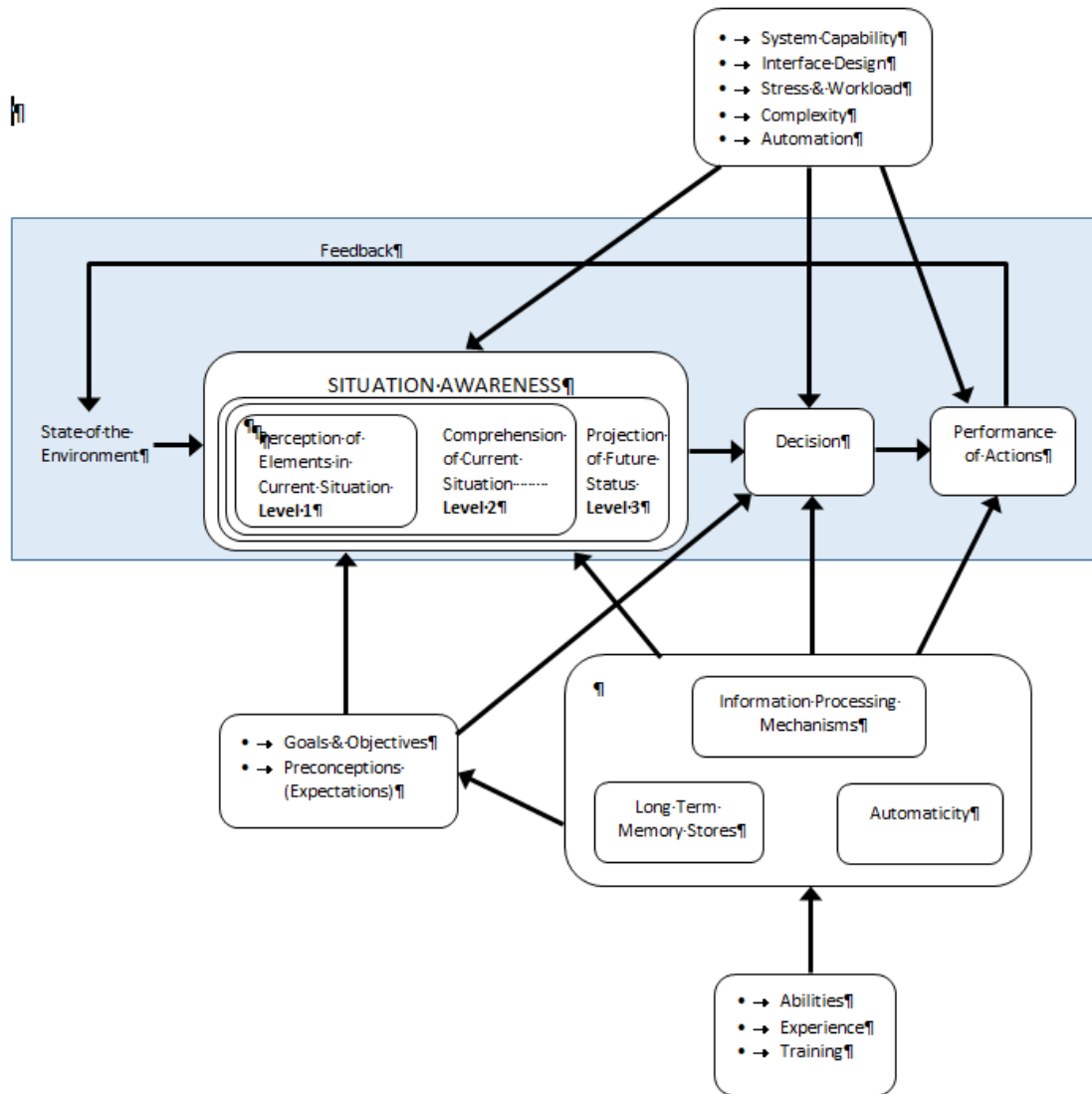


Figure 2.1: The original model of Individual Situation Awareness (Endsley, 1995, p. 35).

SA has become the focus of an increasing number of studies in healthcare and nursing. In their review of the methods that nursing researchers use to study SA, Orique and Despins (2018) identified 40 peer-reviewed research articles in which SA was studied in nurses, or in teams that included nurses between 1995 and 2016. I found an additional six articles from 2017 to 2019 in

peer-reviewed journals in which situation awareness of individual nurses, or nurses on teams was studied. Orique and Despins (2018) found that researchers have studied SA directly, or indirectly, a categorization that I found helpful and will use here.

In studies where SA was researched directly, scientists attempt to measure the degree of SA an individual has in a given situation. To measure SA directly, scientists have used tests and questionnaires, but frequently, they use the Situation Awareness Global Assessment Technique (SAGAT). This technique was developed by Endsley (1995) to measure the three levels of SA in a simulated setting. The technique can be applied at the end of a simulation, or at random intervals during a simulation, where the simulation is temporarily frozen, and participants are asked questions to determine their three levels of SA. The scores for each level of SA and SA as a whole are then tallied. The SAGAT was originally developed in aviation, but has since been adapted and used in many other fields, including healthcare (Coolen, Draaisma, & Loeffen, 2019; Crozier et al., 2014; O'Meara et al., 2015; Orique & Despins, 2018).

In one example, O'Meara et al. (2015) used SAGAT scores to measure the improvements in the SA of undergraduate nurses and paramedicine students after three successive simulations. In this before and after study, the participants wore eye tracking devices during a simulation. Immediately after the simulation, the completed a SAGAT questionnaire, and then debriefed using a video that showed them where their gaze was directed, and therefore what they were paying attention to, during the simulation (O'Meara et al., 2015). Once the debriefing had occurred, the participants proceeded to the second and third simulations, where they also debriefed using the eye tracker video technology. Participant SAGAT scores increased with each successive simulation, and students did report benefiting from the video debriefing sessions.

In a recent study of SA in nurses, researchers examined the SA of nurse participants who did and did not use head worn displays (HWDs) of physiologic monitoring. The scientists posited that physiologic patient monitors are often centrally and inconveniently located for nurses, leading nurses to miss important changes in patient condition. They compared the SA of nurses with and without HWDs as they completed a simulated patient assessment and found an improvement in SA when nurses wore the HWD's (Pascale et al., 2019).

SA has also frequently been measured indirectly, which is necessary in natural settings where researchers cannot 'freeze' or stop activities (Orique & Despins, 2018). Indirect measures of SA have been conducted using structured observations in which researchers rate observed behaviours of participants and make assumptions about which behaviours provide evidence of SA. In their study of the factors influencing the non-technical skills of scrub nurses (including SA), Kang, Massey and Gillespie (2015) observed 182 distinct surgical procedures at two different hospitals. They sought to determine if five factors: familiarity with the team, patient acuity, change in scout nurse, the number of times the scout nurse left the room, and the success of the surgery, were associated with observed non-technical skill performance. They found that familiarity with the team and patient acuity had a small positive effect on non-technical skills of scrub nurses at one hospital, but found no relationship between the independent variables and non-technical skills at the other (Kang, Massey, & Gillespie, 2015).

Team Situation Awareness

In healthcare, nurses almost always work in complex, interdisciplinary teams. Key features of teams, as it pertains to SA, are that there is: a) meaningful task interdependency, b) coordination of team members, c) specialised member roles and responsibilities, and d) intensive communication (Salas, Prince, Baker, & Shrestha, 1995, p. 125). While an important part of a

nurses' role is to develop and update his or her own SA, nurses then must contribute their knowledge to what is known as team, or shared SA.

Team SA is the shared understanding of a situation among team members (Stanton et al., 2017). Team SA is the result of individual team members' pre-existing knowledge, the information available in the environment, and the cognitive processing, that occurs by each of the team members (Salas et al., 1995). Team SA may be cyclical in nature as the team members influence the SA of their team members through information sharing (Salas et al., 1995; Stanton et al., 2017). Often, team members require overlapping SA, in spite of having unique responsibilities within the team, and it is the overlapping to SA needs that requires teams to coordinate and share their knowledge.(Wright & Endsley, 2008). The primary method for achieving team SA is communication between team members (Bleakley, Allard, & Hobbs, 2013).

In healthcare, the need for shared SA between team members is obvious. For example, in the ICU setting during a rapid sequence intubation procedure, the nurse, respiratory therapist and physician must all understand the process of the procedure, the equipment required, and the medications that will be administered, even though typically the physician will intubate the patient, the nurse will administer medications and monitor vital signs, and the respiratory therapist will attach the mechanical ventilator. Coordination of knowledge and activities is crucial. If the physician attempts intubation before sedation has been administered, the patient may experience extreme distress; if the respiratory therapist is unaware of oxygen saturations, they may fail to deliver rescue breaths, and if the nurse delivers sedation before the physician and respiratory therapist are ready to intubate, they may cause a cessation of respirations and a medical emergency. The actions and knowledge of the three practitioners are interdependent. In

this example, the respiratory therapist and physician have near-field SA, while the nurse has global SA, and these different views must be communicated (Lauria, Ghobrial, & Hicks, 2019).

Shared and correct team SA can be challenging to achieve because at each of the three levels of SA, there are opportunities for team SA to fail (Wright & Endsley, 2008). At level 1, the team could be working from disparate data; some team members may have more up-to-date knowledge of lab results, or a more thorough understanding of patient care wishes, for instance. At level 2, team members may be working from the same data, but interpret this information differently. At level 3, team members may have the same understanding of the current situation, but make different projections as to what will happen with the patient in the near future. According to Wright and Endsley (2008), the more heterogeneous the team, the greater the opportunity for different mental models and therefore conflicting ideas on how to proceed in a situation. The solution that they provide is effective information sharing (Wright & Endsley, 2008).

Team SA, like individual SA, is studied directly and indirectly. In 2014, Crozier and others developed and validated the Team Situation Awareness Global Assessment Technique (TSAGAT) in trauma team simulation settings that included nurses, physicians and airway managers. The TSAGAT technique sums the individual SAGAT scores of participants to produce a team SA score (Crozier et al., 2014). The technique also allows researchers to compare where different practitioners have shared and divergent SA. For example, participants may all be aware of the same data (vital signs), but interpret the data differently, or anticipate different patient outcomes. This potentially allows researchers or teachers to identify and fill gaps in team SA.

In a recent study, Coolen et al. (2019) conducted a study to determine the relationship between team SA and goal attainment (correct and consensus diagnosis, agreement on primary problem, successful completion of the simulation) in pediatric emergency simulation training. In this study, 24 teams each consisting of two pediatric nurses, one pediatric resident, and one staff pediatrician performed three different pediatric emergency simulations (Coolen et al., 2019). At various phases of the simulation, the simulation was frozen, and individual team members' SA was evaluated. SA was also evaluated at the end of the simulations. The researchers found a positive correlation between team SA and consensus on primary diagnosis and task prioritization (Coolen et al., 2019).

SA of nurse-surgeon teams was studied indirectly using video recordings of instrument transfer during surgical procedures (Korkiakangas et al., 2014). Video recording of real healthcare procedures enables researchers to examine activities repeatedly to discover how SA is displayed using nonverbal cues, and whether this display is understood by other team members (Korkiakangas et al., 2014). In this study, Korkiakangas et al. (2014) videotaped teams that included circulating nurse, scrub nurse, surgeon and anaesthetist, and examined the SA required for efficient transfer of instruments between surgeon and scrub nurse. They found that scrub nurses were frequently oriented to multiple issues at once, including conversation with the circulating nurse, proceedings of the surgery and the position of the surgeon. They found that the scrub nurse was attuned to changes in surgeon body position that signalled the need for a new instrument, and that this attention sped up instrument transfer. They also found that the position of the instrument trolley, and arrangement of the instruments, not only could change the speed of instrument transfer, but was a display of SA on the part of the scrub nurse (Korkiakangas et al.,

2014). The scrub nurse displayed her awareness of how she anticipated the surgery would progress through the arrangement of the instruments on the trolley.

Distributed Situation Awareness

Stanton et al.'s (2006) model of Distributed Situation Awareness (DSA) builds on early models of individual and team situation awareness (Stanton et al., 2006). In this model, SA itself does not change, it continues to refer to the state of being aware of what is going on, but SA is now held by individuals, teams, *and* the sociotechnical systems in which these teams are embedded (Stanton, 2016; Stanton et al., 2017; Stanton et al., 2006). As such, non-human components of the system are thought of as having SA. In a socio-technical system, people and systems interact in ways that are highly complex, and it is difficult to reduce the system to "explainable units" (Stanton et al., 2017, p. 457). The socio-technical systems concept is frequently used in research into high-technology and safety-sensitive environments like aviation and nuclear power (Stanton et al., 2017).

The DSA model has six key components, which I have summarized below from three DSA papers (Stanton, 2016, pp. 1290-1291; Stanton et al., 2017 p. 459; Stanton et al., 2006, p. 3). I have added examples from ICU settings where appropriate.

- 1) SA is an emergent property of a sociotechnical system; therefore, the system is the unit of analysis. For instance, an entire ICU setting would be the unit of study, rather than individual ICU nurses, or even multidisciplinary teams.
- 2) SA is distributed across the system in both human beings and technology. Different people and different technical devices have different 'views' of the system. Just as the nurse and the physiotherapist may have different views of a patient, so too does the ventilator and the IV pump, and so, too, does the unit manager.

- 3) Systems have a dynamic network of information that each human and non-human 'agent' contributes to. Compatible and accurate views contribute to a safe environment. Incompatible views contribute to an unsafe environment. For example, if a ventilator misreads a patient's respirations and incorrectly displays a respiratory rate within safe limits, a nurse may mistakenly believe that the patient's breathing is adequate and take no action to correct the situation.
- 4) Systemic SA is maintained through transactions between agents which can be human-human, human to technology, and technology to technology. Human-human information sharing may be verbal or non-verbal. Human-technology interactions may include a nurse programming an IV pump, or reading numbers and symbols on a monitor. Technology-technology interactions may include downloading of digital information from a piece of laboratory equipment into the electronic health record, or the transduction of a fluid wave from an arterial line into an electrical signal on a monitor.
- 5) The system does not rely on shared SA; it relies on compatible individual SA that connects to form system SA. A nurse and respiratory therapist have individual, but compatible views of a patient's respiratory status.
- 6) One agent may compensate for degradation in another. For instance, a ventilator might incorrectly read 18 breaths per minute, but the patient's oxygen saturation reading is 70% and the nurse assesses that the patient's skin colour is ashen. The nurse and oxygen saturation monitor readings have compensated for incorrect ventilator recordings.

In spite of the complexity of the DSA model, Salmon and others (2017) assure readers that DSA can be studied using the same methods as other forms of SA. These techniques include freeze-probe techniques, real-time probe techniques, self-rating instruments, observation, video and others (Salmon et al., 2017). While it may be possible to study DSA using the same techniques, however, I could find very few examples of studies of DSA in healthcare or nursing. In one study, Fioratou (2016) et al. specifically used DSA theory to explore the management of major obstetrical hemorrhage (MOH) by anaesthetists. The researchers interviewed 18 anaesthetists and asked them to describe the factors that influenced the management of a difficult MOH case. The anaesthetists described the importance of information gathering from monitors and fellow team members, such as midwives and surgeons, and also of sharing information with the team. Occasionally, they had to convince the surgeons of the seriousness of the hemorrhage. They also described the importance of interacting with, and receiving information from other objects such as suction canisters or swabs (Fioratou et al., 2016). The authors suggest that analysis of events in the operating room benefits from the application of DSA theory, saying that DSA extends the focus of study beyond individual and even teams of clinicians, to include procedures, the physical environment, patients and families (Fioratou et al., 2016, p. 119).

I was unable to find a study of DSA conducted by nurse scholars, or that focussed on nurse clinicians; however, Lin, Chaboyer and Wallis (2014) studied a similar concept, distributed cognition, in the ICU discharge process. They found that ICU patient discharge was a complex, distributed process that involved nurses, charge nurses, physicians, managers, and clerical staff in both the ICU and the receiving ward (Lin et al., 2014). They also found that ineffective communication, competing priorities, and failure to enact organizational policies interfered with the ICU discharge process and with situation awareness. The researchers did refer to 'shared'

situation awareness, in reference to traditional team situation awareness models, but it is clear that their unit of analysis was the entire "cognitive activity system" (Lin et al., 2014, p. 678).

While there are not many studies in healthcare or nursing deliberately incorporating DSA theory, many existing studies can be interpreted in retrospect using DSA theory. Clark, Stanton and Revell (2019) conducted a recent literature review in which they evaluated studies of handover techniques and tools in high risk environments in light of DSA theory, using Stanton et al.'s guidelines for DSA design (Stanton et al., 2017). They found that standardization of handover using a checklist was the most common method used to promote DSA. The second most common method, particularly popular in healthcare settings, was in-person verbal communication that included bidirectional exchange of information (Clark, Stanton, & Revell, 2019). Researchers emphasized that written communication alone is not effective for information transfer in health care environments, and face-to-face communication encourages questioning on the part of the receiver, which allows them to actively participate in filling their knowledge gaps (Clark et al., 2019). Third, studies pointed to the role of training programs in improving DSA, particularly with respect to training on verbal communication skills and use of handover tools (Clark et al., 2019). Finally, the use of technology, such as electronic trackers, was cited as a means to improve handover communication and DSA, a finding particularly relevant to ICUs.

Factors influencing distributed situation awareness. The factors that influence DSA can be broken into individual, team, system and task factors (Stanton et al., 2017; see Figure 2.2). Individual factors are the same as those suggested by Endsley (1995) and include goals, roles, perception, training and experience (Salmon et al., 2017; Stanton et al., 2017). There are several examples of the impact of training on the individual SA of nurses (Cooper et al., 2010; Kang et al., 2015; Lavoie, Cossette, & Pepin, 2016; Stomski et al., 2018). As mentioned previously,

studies using eye-tracking devices demonstrate that perception by nurses is important to SA and performance, and perception can improve and become more sophisticated with feedback (O'Meara et al., 2015).

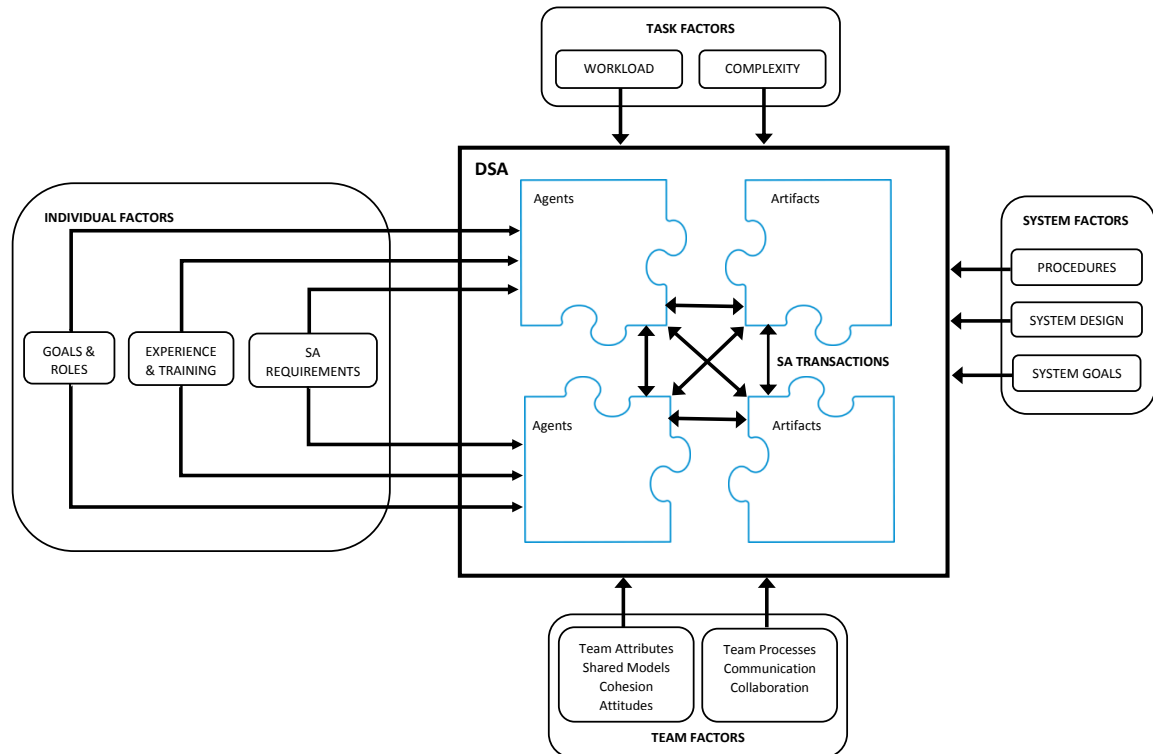


Figure 2.2: The model of Distributed Situation Awareness (Salmon et al., 2017, p. 200).

The team factors that influence DSA include communication, interpersonal relationships, coordination, and decision making (Stanton et al., 2017). Effective communication between healthcare professionals is essential for team situation awareness and safe patient care, and has been studied in healthcare and even ICU settings (Adams, Mannix, & Harrington, 2017; Mullen, Reynolds, Marante, & Avery, 2019; Rose, 2011; Ryan et al., 2019). Some methods of communication in the ICU are formal and structured. These include scheduled verbal and written patient hand over that takes place between members of the same profession, relaying of

laboratory results via the electronic health record, display of patient physiologic information on bedside monitors, the display of nursing assignments and patient location in nursing stations, patient census reports, documentation forms and many others. Others are informal, such as ad hoc communication includes hallway conversations, urgent phone calls, and even post-it notes. The purpose of much of this communication is to relay facts about patients with a goal of taking actions to improve patient care (Reader, Flin, Mearns, & Cuthbertson, 2011). Unfortunately, poor interdisciplinary communication is considered to be a source of healthcare errors, and many barriers to communication in healthcare settings have been identified (Alvarez & Coiera, 2006; Lo, 2011).

Barriers to team communication in clinical settings include professional boundaries, and workflow patterns (Canadian Patient Safety Institute, 2011; Lo, 2011). Professional boundaries refer to the divisions between what is and is not within a professional group's recognized domain of practice (Liberati, Gorli, & Scaratti, 2016). Professional differences arise in part as a result of differences in education, in which professionals are trained in a common language and practices that are not necessarily shared by other professions (Liberati et al., 2016; Tan, Zhou, & Kelly, 2017). The differences are reinforced by traditional workplace hierarchies that make it difficult for professionals to share, and be open to, information from another profession (Dayton & Henriksen, 2007). Professional boundaries can lead to role clarity, which can improve patient care and communication but they can also create distrust, which is a hurdle to information sharing (Dayton & Henriksen, 2007; Lo, 2011). In their observational study, Liberati et al. (2016) noted differences in information sharing between physicians and nurses on neurological wards and intensive care units (ICUs). In the ICUs studied, intensivists openly relied on nursing information and assessments to make clinical decisions, in a collaborative process, while

neurologists did not consult the neurology nurses prior to planning patient care, and wrote prescriptive orders.

Task factors refer to the characteristics of the tasks taken on by individuals or teams that enhance or hinder team performance, such as time pressure workload and task allocation (Stanton et al., 2017). Time pressure and workload can impede DSA by inhibiting the ability of individuals and teams to both communicate and absorb information. In a study of ICU staff, including nurses, ICU capacity strain and high patient to nurse ratios were seen as a cause of poor communication and poor advanced care planning (Bagshaw et al., 2017).

Task interruption has also been proposed as an impediment to SA and task performance. Interestingly, though, the evidence for this in nursing is mixed. In one study of task interruption and its impact on SA, the authors did not find that task interruption decreased the safety of medication administration by nurses (Sitterding et al., 2014). They suggested that task automaticity may play a role; nurses become so expert at administering medications safely and managing interruptions, that they can do so under a variety of conditions.

As early as 1995, Endsley identified system factors as an important influence on SA (Endsley, 1995). These influences continue to be considered important in the emergence of DSA (Stanton et al., 2017). System factors include both technological factors, such as the networking of devices, and human factors, such as policies, procedures and workflow patterns.

Technological factors are important in the ICU as nurses interact with as many as 10 IV pumps, a cooling device, a mechanical ventilator, cardiac monitor, several invasive monitoring devices, an electronic medical record and even electronic beds. In two studies, researchers demonstrated that the organization and display of the information from this technology can improve nursing SA

(Drews & Doig, 2014; Koch et al., 2013). Details of these studies are described in the 'ICU' section, below.

The human side of healthcare systems are arguably more important than technical ones, even in the ICU. For instance, policies and procedures governing patient care practices can improve DSA. In the ICU setting, nurse-driven practices governing patient discharge, such as interactive, standardized communication tools, critical care outreach, and discharge planning, can ensure that crucial patient information is provided to ward staff, and ensure on-going coordination between the ICU and ward before and after discharge (Lin et al., 2014; Peters, 2017). As well, asynchronous workflow patterns also create a significant barrier to teamwork and communication. In their model of interdisciplinary collaboration, Baggs and Schmitt (1997) identify Being Available (in place and time), and Being Receptive (indicating interest, trust and respect), as requirements for teamwork and collaboration. Collins and Currie (2009) extended the model specifically to address interprofessional collaboration. Unfortunately, in many intensive care units intensivists, respiratory therapists, physiotherapists, all arrive in the ICU at different times, minimizing contact with each other, and requiring critical care nurses to spend time tracking down staff to provide them with the most up-to-date information.

Situation Awareness and Communication in the ICU

There is increasing interest in SA and its role in critical care. At this time, however, most research has been conducted in simulated environments. In one literature review, the authors identified high levels of SA as critical to patient safety, and make two recommendations for improving SA in critical care environments (Lauria et al., 2019). First, they suggest that clinicians should be encouraged to perform active SA building; they should actively seek patient information, rather than relying on information to be pushed to them via alarms (Lauria et al.,

2019). Second, they recommend that active SA building become a habit, and suggest that this can be achieved by a) connecting SA building tasks with required tasks such as attaching transport monitors, b) systematizing SA building through checklists and routines, and c) evaluation and follow-up with clinicians to ensure that the practice is being followed (Lauria et al., 2019).

In another review, 200 critical incident reports from critical care and anaesthesia environments were reviewed for potential gaps in SA (Schulz et al., 2016). Of the 200 cases, 81.5% were associated with gaps in SA, with 38% involving gaps in perception, 31% involving gaps of understanding, and 12% associated with gaps in projection (Schulz et al., 2016). Incidents associated with gaps in perception included cases with missing or imperceptible data, and cases involving errors in understanding and projection often resulted from incomplete mental models of the current situation (Schulz et al., 2016).

Research into SA among ICU nurses is limited, but there are a few studies available. Researchers used a high fidelity simulation of septic shock to evaluate the situation awareness and teamwork of 54 ICU nurses (Gundrosen, Solligård, & Aadahl, 2014). They found that the simulation, which took place in the ICU environment, was a useful tool for identifying individuals who required support to meet workplace expectations of technical skill and teamwork (Gundrosen et al., 2014).

As well, health informatics researchers have used SA as a framework to examine the effectiveness of different types of information displays (Drews & Doig, 2014; Koch et al., 2013). In one study of vital sign monitoring displays, nurses were able to interpret information more quickly and accurately when the display included waveforms as well as numbers, than when the displays offered numbers alone (Drews & Doig, 2014). In the other, nurses were better able to

retrieve input data from IV pumps when this data was integrated with their cardiac monitoring displays, than when the information was available separately on the IV pumps (Koch et al., 2013).

In one study of SA in the ICU setting, researchers observed 34 morning rounds events, and then individually asked the nurse and physician participants in those rounds about how they expected patients to progress over the next 48 hours (Reader et al., 2011). They found that in spite of rounds taking place, team members anticipated different trajectories for the patients over 50% of the time, though this improved when team members were actively involved in developing patient recommendations, their ability to accurately predict patient progress improved. They concluded that team processes, such as rounds, do not automatically improve team SA (Reader et al., 2011).

While few studies explore SA in the ICU, there is more research regarding communication among ICU clinicians. As mentioned above, prominent authors in the field of SA research have identified communication as a key component driving SA in teams (Endsley, 2015; Sorensen & Stanton, 2016; Stanton et al., 2017; Stanton et al., 2006). In the ICU setting, interdisciplinary rounds have been introduced as a means to improve collaboration and communication and therefore improve patient care (Artis et al., 2017; Gurses & Xiao, 2006; Lane, Ferri, Lemaire, McLaughlin, & Stelfox, 2013; Reader et al., 2011). Usually, interdisciplinary rounds take place at a scheduled time in the morning, where professionals from all disciplines, nursing, medicine, pharmacy, respiratory therapy, dietary, physiotherapy, and others, including families, come together at the bedside to discuss patient status, goals of care and treatment decisions. During rounds, a representative from each profession and discipline is given a platform to offer the team their unique knowledge and perspective on the patient, and a

plan of care is developed that incorporates all of this unique knowledge. By bringing professionals together for the express purpose of communication, interdisciplinary rounds address some of the antecedents to interdisciplinary communication, such as being available in time and place, which were identified by Braggs and Schmitt (1997), and Collins and Currie (2009). Indeed, studies have shown that interdisciplinary rounds can improve healthcare team communication and satisfaction (Artis et al., 2017; Cypress, 2012; Gurses & Xiao, 2006; Lane et al., 2013).

Nurses generate a tremendous amount of patient information that is useful for care and treatment decisions. This information is generated through conversations with patients and families, patient assessments, history taking, and the delivery of patient care. The information is transmitted to other healthcare team members through documentation and conversations. The routine practice of interdisciplinary rounds provides nurses with a platform and space to share their unique knowledge of patients and families with other healthcare team members (Lane et al., 2013). Studies have shown that interdisciplinary rounds can increase nurses' participation in decision making and improve nursing care (Lane et al., 2013). However, more research is needed to fully understand the process of ICU rounds on information sharing by nurses. Therefore, for this study, I explore the research question: How does patient care information flow among nurses in intensive care units with and without interdisciplinary rounds, and how does such information sharing impact patient care?

The current research into SA, DSA and interdisciplinary rounds provides a firm foundation for the current study. Models now exist for individual, team, and distributed SA. These models identify factors that influence SA and DSA, such as individual factors (experience and education), task factors (such as complexity and workload), and system factors (such as

system design). However, there are few studies in the ICU setting to support or refute DSA theory, and even fewer that emphasize information sharing by ICU nurses. This study builds on the current knowledge base by foregrounding nursing's specific contribution to distributed situation awareness in ICU settings, and explores whether this role changes in ICUs with or without interdisciplinary rounds.

Chapter 3 - Methods

In this chapter, I present the methods for this study. I begin by describing the history, data collection methods, and data analysis strategies used in rapid qualitative inquiry (RQI), the research method for this study. Then, I provide the details of the methods used here, including preparation for the study, data collection and data analysis. I conclude with a brief description of the ethical considerations.

Rapid Qualitative Inquiry

I used an adapted form of rapid qualitative inquiry (RQI) to understand the flow of nursing information and its impact on patient care in intensive care units with and without interdisciplinary rounds. RQI has been evolving since the 1970s, and is used today in research in health information science and public health. It is also used in evaluation in many fields, such as international development and education (Beebe, 2014; McMullen et al., 2011). Below, I describe the key features of RQI and explain why this method is suitable for studying the proposed research question.

The most important feature of RQI is that it is a *qualitative* approach to inquiry. Qualitative research methods derive primarily from the fields of anthropology and sociology – that is, fields in which researchers study human beings (Patton, 2008). The study of human beings requires methods that are distinct from quantitative inquiry, because human behaviour is influenced by purpose, emotions, culture, empathy and plans (Patton, 2008). Qualitative researchers assume that events can only be understood when seen in context, and that participants must speak for themselves (Beebe, 2014). Qualitative methods have been developed that are exploratory and descriptive in nature, helping researchers understand "how" phenomena occur and "why" (McMullen et al., 2011). Therefore, the question of how information sharing

proceeds in an ICU is well suited to a qualitative approach. In fact, scholars of both nursing and health information science use qualitative research methods extensively in their work (Barosso & Cameron, 2013).

The two qualitative research traditions that have had the most influence on RQI are ethnography and case study research (Beebe, 2014). Ethnography is one of the oldest qualitative research methods (Barosso & Cameron, 2013). It first arose in anthropology as a rigorous way to scientifically describe cultural groups, or to study distinct problems within small groups of people (Barosso & Cameron, 2013). Researchers seek the "insider's perspective" of the culture of interest, while holding an awareness of their own perspective. Typically, researchers are immersed in a community for extended periods of time, with very little pre-structured instrumentation or data collection tools (Patton, 2015). Researchers use observation, conversation, interview and participation, to study people through their behaviours and the materials that their cultures produce (Beebe, 2014; Patton, 2015).

Both nurses and health informatics researchers have used ethnography for decades. According to Keen and De Chesnay (2014), ethnography is well suited to studying nursing phenomena of interest, and nursing practice benefits when nurses have a deeper understanding of people from cultures other than their own. Madeline Leininger, an influential scholar of nursing, developed culture care theory and ethnographic methods to study nursing phenomena of interest in different cultural context, coining the term "ethnonursing" (Leininger, 1997). Since Leininger, nurses have continued to use ethnographic methods to study different cultures (Keen & De Chesnay, 2014; McFarland, Mixer, Webhe-Alamah, & Burk, 2012). They have even used ethnography in ICU settings to study the trauma experience of ICU patients (Paiva, Rossi, Silva, & Spadoti, 2010).

Health informatics scholars use ethnography to study human-technology interactions (Ackerman, Gleason, & Gonzales, 2015). These studies often explore the use (or lack of use) of new technologies by healthcare providers, and their impact on patients' health outcomes. Researchers state that ethnography can generate useful insights into factors that influence technology use, and therefore ethnography can be used to improve the implementation of healthcare information technology (Borycki & Kushniruk, 2015).

Case study research is the other important research tradition on which RQI has been built. Case study was developed in sociology as a method of in-depth study of one case or system (Beebe, 2014; LoBiondo-Wood, Haber, & Singh, 2013). The focus of a case study can be an individual, family, community, a setting, or an organization (Barosso & Cameron, 2013; Patton, 2015). *Intrinsic* case studies are designed to better understand a single case, with no intention of comparing that case to others (Barosso & Cameron, 2013). *Instrumental* case studies are conducted with the intention of understanding an issue, or supporting or challenging a generalization (Barosso & Cameron, 2013). Case studies rely on the extensive use of multiple data sources, such as observations, interviews, documents and reports (Beebe, 2014).

One example of case study research in nursing informatics is a study by Luo, Yang and Harrison (2018) that explored the use of technology in online nursing education. The researchers used surveys, observations and student reflections to help them understand the impact of technologies including Google Doc, Doc Hub and infographics applications on student learning and engagement. They found that Internet-based technologies can be used to facilitate learning and engagement, but they also found that if students are unfamiliar with the technology it can impose a large additional cognitive load on top of course requirements (Luo et al., 2018).

Rapid Qualitative Inquiry (RQI), uses the techniques of ethnography and case study in an attempt to rapidly develop an understanding of a unique and poorly understood setting (Beebe, 2014). RQI field work typically takes just 4 days to 6 weeks; however, according to Beebe (2014), the speed of the inquiry is the least important defining characteristic of the research method. RQI is defined by Beebe (2014) as "intensive team-based qualitative inquiry with a) a focus on the insider's perspective, b) multiple sources and triangulation, and c) using iterative data analysis and data collection to quickly develop a preliminary understanding of a situation." (p. 6). The focus on the insider's perspective may be the most important concept in RQI.

Insider's perspective. In RQI research, as in ethnography, it is crucial to understand a phenomenon from the perspective of the people experiencing it (Beebe, 2014). This insider's perspective is known as the "emic" perspective, which can be gained through in-depth interviewing and conversation. Specifically, researchers strive to understand the ways in which local people understand and categorize their world (Barosso & Cameron, 2013; Patton, 2015). The emic perspective contrasts with the "etic" or outsider perspective of the researcher. Researchers strive to recognize and minimize their own biases and perspectives in order to use language and study phenomena in such a way as to minimize their impact on the phenomena (Barosso & Cameron, 2013; Patton, 2015). Where the etic perspective can be useful is in the translation of the emic perspective for other audiences.

Multiple data sources. Multiple data sources and data triangulation are crucial for RQI (Beebe, 2014; McMullen et al., 2011). The purpose of data triangulation and the use of multiple data sources is not to ensure that different sources of data "agree" so that a single truth of a phenomena can be presented, but rather to provide rigor, depth and breadth to the understanding of the phenomena (Beebe, 2014; McMullen et al., 2011; Patton, 2015). Triangulation can be

achieved by using multiple researchers, multiple theories and perspectives, multiple disciplines in both participants and researchers, and multiple sources of data. Data sources typically include interviews, unobtrusive observation and field notes, maps, and other sources of documentation. Maps in particular can be useful communication tools to help describe the phenomena to other audiences. The extensive use of team-based research and multiple data sources is one way in which RQI compensates for the shortened duration of field work (Beebe, 2014).

Iterative data analysis and data collection. In RQI research, data collection and analysis occurs in repeated, reflexive cycles (Beebe, 2014; McMullen et al., 2011). Blocks of time for data collection and analysis are deliberately scheduled in a repeated pattern to ensure that a preliminary analysis is conducted before further data is collected (Beebe, 2014; McMullen et al., 2011). The purpose of iterative data collection and analysis is that it helps researchers refine their research strategy, and also be open to discovering the unexpected. Preliminary data analysis in between bouts of data collection allows researchers to change or add data sources, change interview guides and data collection tools, and even alter research questions (Beebe, 2014; McMullen et al., 2011).

Data collection begins prior to contact with participants. Field guides filled with information on study settings and participants (see below) are developed prior to contacting participants, and examination of this information itself helps researchers to refine research tools (McMullen et al., 2011). Next, researchers may conduct interviews, perform preliminary analysis of those interviews, move on to collect new interviews, or conduct observations, perform more analysis, and so-on until saturation or redundancy has been achieved and more data, or new data sources, do not contribute new information (Beebe, 2014; McMullen et al., 2011).

RQI methodology places heavy importance on immediate data analysis and reflexivity (Beebe, 2014; McMullen et al., 2011). Reflexivity is a key concept in qualitative inquiry (Patton, 2015). It reminds researchers that the observations they make are influenced by their history, education, culture, social status, political leanings and ideologies (Patton, 2015). For study results to be credible, researchers must acknowledge their potential biases and consider how they may influence data collection and interpretation. Reflexivity also prompts researchers to consider the factors that may influence participant responses to being interviewed and observed, and factors that may influence audience responses to the study (Patton, 2015).

Between each data collection step, data analysis includes data condensation and coding, data display, and drawing conclusions (Beebe, 2014; McMullen et al., 2011). Data condensation and coding is required to focus and transform enormous quantities of text data into meaningful categories (Beebe, 2014). Beebe (2014) recommends using a total of 5-6 codes, with sub codes as needed, when coding the data. Data displays, such as matrices, graphs or maps are organized displays of information that assist researchers and eventually readers in understanding what is happening (Beebe, 2014). Finally, conclusion drawing includes identifying patterns and themes, identifying connections in time and space, and making contrasts and comparisons. Once these three steps are complete, even in a very preliminary way, new data collection can take place.

The data analysis process presented above is very much like content analysis. Content analysis is broadly defined as qualitative data reduction and sense-making (Hsieh & Shannon, 2005; Patton, 2015). Analysis of qualitative data may reveal patterns of interest, which are then folded into categories or themes in an effort to find meaning in the patterns (Hsieh & Shannon, 2005; Patton, 2015). Content analysis may begin with sensitizing concepts derived from the

literature, which provide direction for researchers, giving them a place to look (Patton, 2015). These sensitizing concepts guide field observations or the construction of interview tools.

Once data has been gathered, both inductive and deductive analysis may be used. In inductive analysis, the researcher analyzes the data for new concepts or explanations that may arise during the study (Patton, 2015). Inductive analysis may be followed by deductive analysis in which these new concepts may be examined against previous studies to determine if they support existing theories (Patton, 2015).

In addition to inductive and deductive analyses, content analysis can include exploring both the emic and etic understanding of a phenomenon. Understanding the emic perspective of a phenomenon often involves interviewing participants, and using their language to categorize phenomena of interest (Patton, 2015). Meanwhile, understanding the researcher's (etic) perspective is also valuable because a) it ensures awareness of any bias that the researcher may introduce, and b) the researcher may be able to tie the emic perspective to the broader literature (Patton, 2015).

Extensive preparation. Extensive pre-fieldwork preparation is identified by McMullen and others (2011) as an important component of successful RQI. Prior to engaging in fieldwork, they recommend producing a field guide to support the research team in their data collection efforts (McMullen et al., 2011). The field guide contains a site profile, schedule of site visits, a fact sheet explaining the research, a schedule of interviews, field note guides and interview guides (McMullen et al., 2011). How this extensive preparation differs from the preparation done prior

to embarking on all types of research is unclear, however, it does provide a useful reminder of the steps to take prior to engaging with participants on site.

Credibility. The credibility of RQI rests on the pillars of extensive preparation, emphasizing the emic perspective, data triangulation, iterative data collection and analysis, and teamwork (Beebe, 2014). Without these elements, according to Beebe (2014) RQI cannot compensate for the shortened duration of fieldwork as compared to ethnography. I would add another caution. RQI is often used to either obtain a preliminary understanding of a phenomenon, or to gain entry to settings in which prolonged fieldwork is not an option (Beebe, 2014). Researchers must take care to analyse their data carefully, and not draw conclusions from their research that cannot be supported by their data.

The main difference between this study and the RQI process is that I did not use team-based data collection and analysis. While this is not ideal, it was not feasible because of the limited scope of this study. I examined a single process, information sharing, in two intensive care units. Conversely, in larger RQI studies, health informatics teams of 4-5 investigators might study information systems of an entire hospital over 4-5 days with this method (McMullen et al., 2011).

Nursing Research using RQI

RQI is not frequently used by nurse scholars, though there are a few examples of RQI research. In one example, Clarke et al. (2016) used a rapid assessment of Cambodian health professional regulation to provide a foundation to develop a new regulatory framework for nursing (Clarke et al., 2016). They used a rapid team-based approach because this work was a high priority for the Cambodian government. Over three months, they reviewed policies and laws pertaining to health regulation, conducted interviews with regulatory stakeholders, provided

questionnaires to healthcare professionals, and asked regulatory councils to conduct a self-assessment. Likewise, Ng'ang'a and others (2014), used RQI to conduct a study of nurse's experiences in a women's hospital in northern Vietnam (Ng'ang'a, Woods Byrne, & Anh Ngo, 2014). Using a classic RQI approach, they used interviews, observations and a review of nurse's journals to develop an understanding of the priorities and experiences of their study participants. Both studies contain hallmark features of RQI, including multiple data sources, team-based research, and seeking the insider's perspective. In both cases, however, there was no mention of using an iterative approach to data collection and analysis.

Health Informatics and RQI

RQI is more frequently used as a method of inquiry in health informatics. This may reflect the roots of the method in evaluation research (Beebe, 2014), and the fact that many health informatics scholars have an interest in evaluating information systems in real-world healthcare settings. Ash et al. (2008) and McMullen et al. (2011) have encouraged the use of RQI and Rapid Assessment Process in studies in which researchers wish to understand how information systems are used, and why they are successful or unsuccessful. They recommend these methods because they can be conducted with limited disruption to fast-paced, high value workplaces, and produce robust results rapidly so that program implementers can adjust their implementation or optimization of a health information system (Ash et al., 2008; McMullen et al., 2011).

There are many examples of RQI used in health informatics research. For example, Ash and others (2015) used a rapid assessment process to understand the perspectives of clinical decision support of different types of healthcare providers. In this study, a team of 6-8 researchers visited 15 separate healthcare facilities, where they performed observations, and

conducted interviews with nurses, physicians, pharmacists, health informaticians, and many others (Ash et al., 2015). In all, they conducted 206 interviews and 268 hours of observations, and used inductive thematic analysis to analyse their data. The study took 5 years before concluding their study. This may not seem "rapid", but the intentional and condensed time in the field made the study feasible in challenging healthcare settings. In a different study, Wright et al. (2015) used RAP to identify challenges and best practices in implementing clinical decision support at four healthcare institutions in the United States. They used site visits, interviews and information system demonstrations for data collection (Wright et al., 2015). They also analysed data iteratively, conducting team debriefings after each site visit, and team transcript reviews after each interview (Wright et al., 2015). With this classic use of RQI, the researchers identified eight challenges and eight best practices in implementing clinical decision support in healthcare settings.

To my knowledge, RQI has not explicitly been used to study situation awareness (SA). SA has, however, been studied extensively using qualitative methods such as participant interviews (Haber, Ellaway, Chun, & Lockyer, 2017), participant observation and grounded theory analysis (Reay, Rankin, & Then, 2016), focus groups (Goldenhar, Brady, Sutcliffe, & Muething, 2013) and participant notes (Reader et al., 2011). The diversity of qualitative research methods used to conduct research into situation awareness supports the use of RQI to study SA in this study.

Data Collection

Data collection goals. For this study, data collection was aimed at capturing:

1) What patient and family-specific information is generated by, or unique to, nursing in these environments?

2) How, where, and why is information shared with other members of the interdisciplinary team?

3) What is the impact of nurse information sharing on patient care?

4) What factors influence information sharing by nurses?

Setting. Data collection took place in two Interior Health ICUs. Site A does not have daily interdisciplinary rounds. Site B has a long-standing practice of daily interdisciplinary rounds, with rounds occurring for at least a decade.

Site visit preparation.

Pre-visit site profile. Prior to seeking participants for the study, site profiles of Site A and B ICU's were prepared to provide context for the study. See table 3.1 for details.

This Space Intentionally Left Blank

Table 3.1: Characteristics of pre-site profiles developed for the two participating ICUs.

Site Profile Item	Rationale
Physical layout	An understanding of the physical layout in advance helped in the anticipation of nursing information sharing and workflow patterns. It contributed to the development of data collection forms, and mapping of information flow.
Patient population	Provided context for understanding nursing assignments.
Nursing assignments	This helped me schedule times for site visits, and anticipate the acuity and number of patients that nurses care for.
Composition of interdisciplinary team	Contributed to understanding of different care levels provided by interdisciplinary team in the ICUs.
Model of physician care	Provided context for selecting study sites and for understanding workflow in each ICU.
Composition of rounds	Assisted with study site selection, provided context during observations.

Participant criteria and recruitment. The inclusion criteria for the nursing participants were that they work as staff nurses in the participating site ICUs. I developed a recruitment email and recruitment poster for nursing staff. At both sites I had a local liaison assist with recruiting by sending the email and poster out to ICU staff. At Site A, the emails and poster elicited three volunteers, and a fourth nurse volunteered while I was onsite performing observations. At Site B, the local liaison recruited all participants by personally encouraging them to participate.

Research fact sheet. The purpose of this sheet was to provide a concise written description of the research to anyone who had questions about the research but did not need to provide informed consent. The sheet was based on the information provided in the informed consent, and included information on the purpose of the research, scope of the research, data collection and distribution, and ways in which data will be secured (Appendix A). The research sheet was provided to one physician at Site A who had questions about the research. Two other

health professionals (nurses) who had questions about the research were satisfied with a verbal explanation and declined to receive a written description.

Informed consent. Informed consent documents were required for nurse participants and also for patients and families of the nurses that I was shadowing. For nurses, the consent forms enabled me to shadow and interview them (Appendix B). For patients and families, the consent forms enabled me to review patient data, and enter the patient's room, and ask questions (Appendix C). Ultimately, I did not perform interviews of patients and families as I found this to be frequently inappropriate and not required for the study (see Ethical Considerations, below). The interviews were also not feasible because they required sustained focus, which interrupted my observations of the nurse and information sharing the primary focus of the study.

Observation data collection sheets. I recorded a) the type of information collected (i.e. vital signs, history, goals of care), b) the ways the information is shared (i.e. documentation, personal conversations, phone call), c) the location in which the information is shared (i.e. nursing station, hallway, bedside), d) people to whom the information is shared (nurse, respiratory therapist, physician, etc.), e) context (rounds, one-on-one conversation) g) time of day in 15 minute intervals, and f) the outcome of that information sharing with respect to patient care (i.e. change in mobility plan or medication). During my first observation day I used prepared data collection sheets (Appendix D), but found them to be unhelpful and in fact slowed me down in data collection as I attempted to categorize interactions while documenting them. On all subsequent days I captured observations on blank paper. Data was transcribed and organized into an excel spreadsheet.

Interview guide. The purpose of interviews was to gain participant perspectives on nurses' information sharing in ICU, to obtain a second source of data for data triangulation, and

to provide an opportunity for participants to confirm, refute or adapt the model of information sharing that emerges from field observations. Interviews were conducted spontaneously as opportunities arose. I worked from an interview guide (Appendix E), but found that interviews were often interrupted, and the result was that interviews became a day-long conversation about nurse information sharing and interdisciplinary rounds. Nursing responses to questions were documented in field notes and analysed separately (see below).

Data collection for chart review. The purpose of the chart review was to provide data triangulation for the data collected during observations and interviews. Specifically, I look for documentation by RNs and other healthcare professionals of a) the type of nurse-specific information collected b) the ways, location, context and people with whom the information was shared, and c) the outcome of that information sharing with respect to patient care. I reviewed documentation sources from all interdisciplinary practitioners for the patient, dates and times in which I was in the intensive care units performing observations. I reviewed the documentation of all healthcare practitioners for each patient that study nurses cared for (N=11), for the date that I conducted observations. I collected information from chart reviews and added it to the same spreadsheet as the field observations to facilitate data analysis, making it easier to see potential links between my observations of nurse information sharing and the documentation and patient care decisions by other healthcare providers.

Data Analysis

To facilitate rapid data analysis and reflexivity, I conducted four phases of data analysis (see Figure 3.1 for a summary of the data collection and analysis process). Preliminary data analysis took place immediately after each observation session. For example, I collected data from 0700-1500, and then simply read the field notes and made margin remarks on the field

notes the same day. This preliminary analysis served three purposes. First, it helped me to develop a preliminary mental model of information sharing in the ICU, including the types of information, and locations, methods and contexts in which information is most frequently shared, and that most frequently impacts patient care. This new understanding of information sharing sharpened my observations of future nurse participants. Second, the preliminary model helped me identify when I had conducted enough site observations. By the eight day of site observations, no new understanding of nurse information sharing was emerging from the field notes, or being provided by nursing staff, so I determined that I had reached data saturation and did not need to conduct more observations. Finally, I reflected on the strength of the interview tool and field guide and made adjustments to the data collection tool them prior conducting observations at Site B.

This Space Intentionally Left Blank

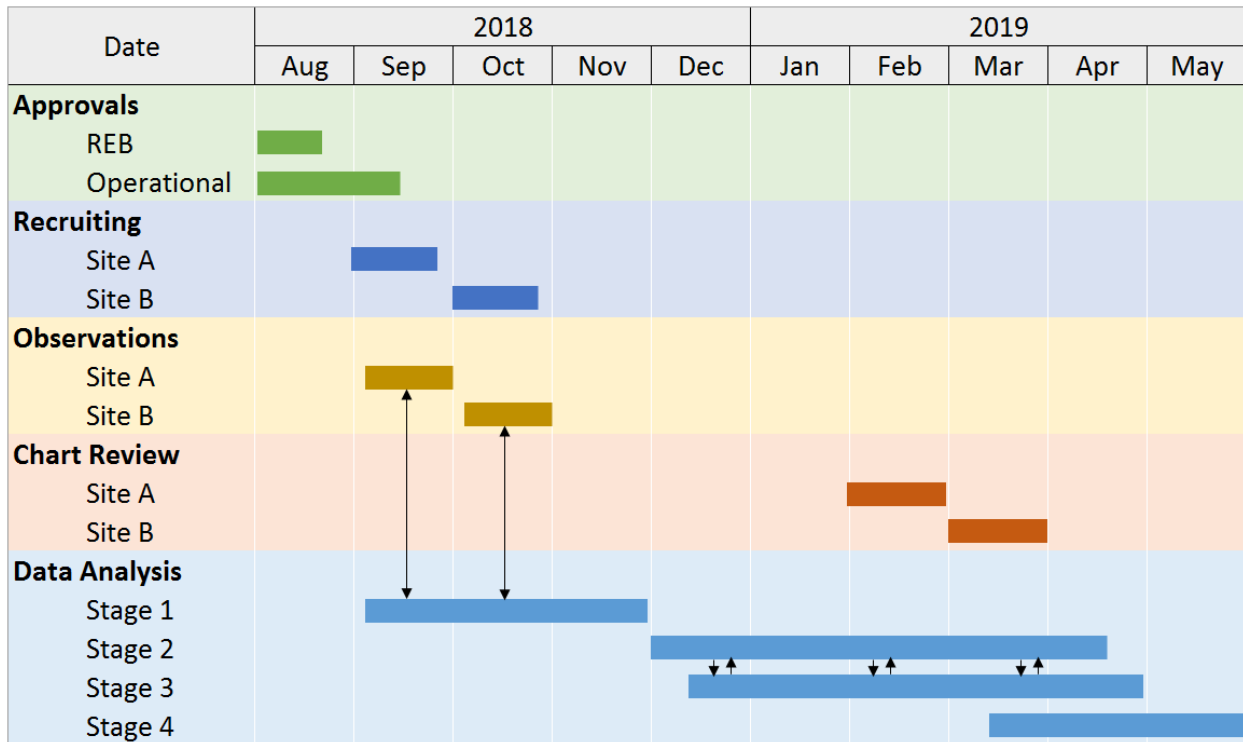


Figure 3.1: Summary of the data collection and analysis process. Arrows indicate processes that influenced each other. For example, the process of observations changed after Stage 1 Analysis (immediate reflection), and coding of observations changed when interview data was considered.

In the second stage of data analysis, I transcribed the field notes into an excel spreadsheet. The purpose of this step was first to immerse myself in the data so that I could code, condense and theme the data. Data transcription required approximately 4 hours of transcription for every day of observations, and was immensely helpful in coding, categorizing and understanding the data, I used conventional content analysis, using the language and phrases of study participants to identify themes and patterns in the data, as described by Patton (2015) and Hsieh et al (2005).

During this stage of analysis, I coded and counted different types of information exchange. When examining the different types of people and equipment that nurses exchanged

information with, I defined an interaction as unbroken engagement with a particular person or item. If a second person of a different 'category' joined the conversation, this was also recorded. For instance, if an RN was speaking with another RN, this was noted as a discussion with an RN; if an RT joined the conversation, with was noted as discussion with RT. Therefore the total number of interactions cannot be added to determine the total number of information exchanges that the RN engaged in.

To determine how information was exchanged, I used the framework provided by the British Columbia College of Nursing Professionals (2018) and only included information exchanges with human beings. Synchronous information exchange involved in-person face-to-face discussion. Asynchronous information exchange included telephone, text, fax, Vocera, and email information exchanges. Linear information exchange involved written documentation.

To determine where information was exchanged, I divided each ICU into five Zones. Zone 1 was the room of the patient or patients that the study nurse was caring for on the day of observation. Zone 2 was the nurses' workstation. Zone 3 included the ICU outside of Zone 1 and 2 and not including other patient rooms. Zone 4 included all other patient rooms, and Zone 5 included all areas outside of the ICU. I made the distinction between these zones because nursing activities are distinct in these areas. In Zone 1, for instance, patient care, assessments and conversations occur. In Zone 2, documentation and care planning tend to occur. In Zone 3, nurses may gather equipment gathering and connect with other staff. In Zone 4, nurses assist their colleagues in caring for patients, and in Zone 5, trips to diagnostic imaging often take place. For an illustration of the five zones in Site B ICU, see Figure 3.2 below. The pink area is Zone 1, the patient room. The small green rectangle is Zone 2, the study nurse's workstation. The dark

blue areas are Zone 3, the area of ICU outside of patient rooms. The light blue area is Zone 4, other patient rooms. The grey area is Zone 5, outside of the ICU.

This Space Intentionally Left Blank

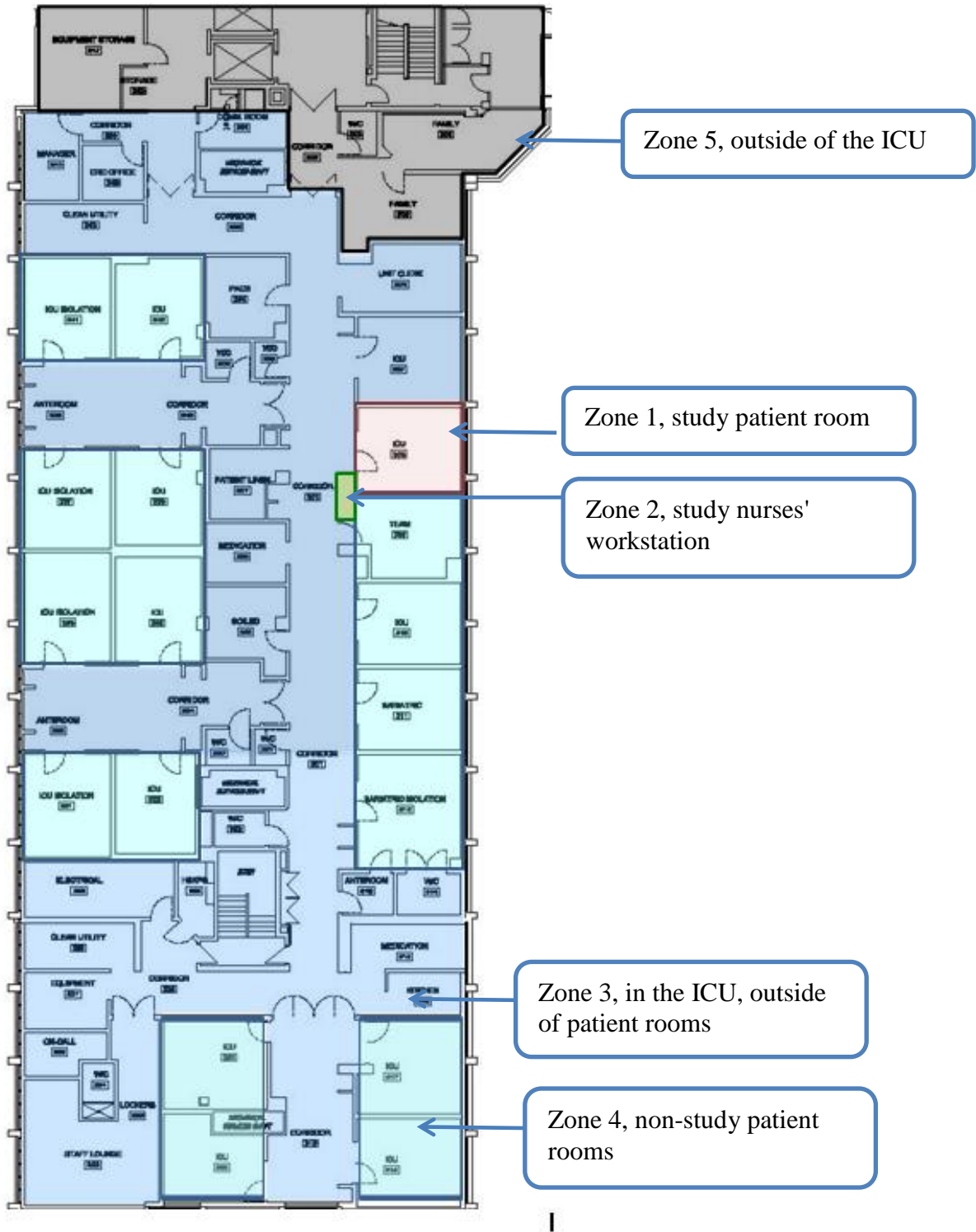


Figure 3.2: Spatial zones in the Site B ICU. The same zones were applied to the Site A ICU.

The percentage of time nurses spent in each Zone was a simple estimate based on the number of movements a nurse made in each 15 minute period. For example, if in a 15 minute block the nurse spent time in Zone 1 and 2, I estimated equal time spent in each area, or 7.5 minutes. If a nurse shared information in 10 locations in 15 minutes, I allotted 1.5 minutes per location. Therefore, the amount of time spent in each zone is an estimate only.

In the third phase of data analysis, I "folded in" information from conversations with nurses. I compared what nurses were telling me about information sharing with what I had observed, taking care to ensure that I was using participants' language when organizing the data. I used direct quotes when possible, though admittedly these are limited, partly because I was taking notes by hand and not digitally recording their responses. Interestingly, I found that the categories and phrases that I used during field observations were the same ones verbalized by nurses. This may be because I am a nurse myself, who spent 10 years in a critical care environment, or it could be that my field notes were influenced by the language of the nurses as I was following them. In an attempt to confirm my results, I emailed a preliminary analysis of the factors influencing information sharing by ICU RNs to the nurse participants (Appendix F), however, I did not receive a response.

In the fourth phase, I folded in the chart reviews to determine if the documentation provided by nurses and other healthcare professionals provided additional information to the results emerging from the data analysis.

Data Presentation

The data were presented in two ways. First, I presented text descriptions of the data, including the context, nurse and patient participants, how information sharing took place in the

two ICUs, and the factors that influence information sharing by nurses. Then, I created a summary diagram to illustrate the findings.

Ethical Considerations

This study was approved by the Research Ethics Boards of the University of Victoria and Interior Health on August 9th, 2018 (Appendix G). Operational approval to visit the ICUs and to review patient charts was obtained from Interior Health on September 12, 2018 (Appendix H). While all of the ethical considerations – participant autonomy, informed consent, and data management and security – were important, two particular ethical considerations stood out in this study. The first is the sensitivity of the setting. In modern ICUs, mortality rates are as high as 25% (Kelly, Fong, Hirsch, & Nolan, 2014). Patients are often intubated and sedated and require substitute decision makers. Many patients and their loved ones do not know if they will survive their ICU stay, or even if they will survive the next 24 hours. Indeed, five out of the eleven patients who were observed for this study did eventually die. Two patients died during my observations shifts. This meant that gaining consent from patients or family members had to be approached with extreme sensitivity. Additionally, even when patients did appear able to provide consent themselves, and were able to sign consent forms, I confirmed consent with a family member. In spite of this, family members and patients readily consented to being observed, even when their loved one was dying. In the two instances where the patients died during my observation shifts, the loved ones consented, using almost the same words "Anything we can do to help you." Their consent was an incredibly humbling and gracious gift. In one of these cases, even though the family did not ask me to, I remained outside of the patient's room.

A second ethical consideration was that I had been, until three months prior to the study observations, in a position of informal leadership in intensive care as the clinical nurse specialist in critical care. Nurses, particularly at Site A, sometimes looked to me for guidance when a patient's condition changed. At the end of my observation day on September 16th, VN3 took me aside and asked if I had any feedback for her. I had to be very clear with the nurse participants that I was not judging their performance.

Chapter 4 - Results

This chapter begins with a description of the study context for each ICU, including the physical layout, nursing staffing models, physician care models and sources of information for nurses. This is followed by a description of the nurse and patient participants, and brief sketch of the conditions in the ICUs on the days of the study. I then present the study results, comparing how, where and with whom critical care nurses in each ICU share information. I complete the chapter by sharing how information sharing impacted patient care, and what factors that influenced information sharing by the RNs.

Study Context

The study context is summarized in table 4.1, and summarized in the sections below.

Table 4.1: Characteristics of the ICU study sites.

Site Profile Item	Site A	Site B
Physical Layout	Modern, large patient rooms, workstations adjacent to patient rooms, linear layout. 6 ICU beds, 4 CCU beds	Modern, large patient rooms, workstations adjacent to patient rooms, linear layout. 11 ICU beds, 2 CCU beds, 4 step-down beds.
Patient Population	High acuity tertiary ICU; majority of patients mechanically ventilated and on high dose vasopressors and inotropes.	Regional ICU; range of patients from mechanically ventilated and on vasopressors to lower acuity patients with single system disease.
Nursing Assignments	One or two patients per nurse.	One or two, rarely three, patients per nurse.
Composition of interdisciplinary team	Large team including ICU-dedicated physiotherapists, rehabilitation assistant, pharmacist, respiratory therapist, and dietitian.	Only nurse and physician dedicated to ICU, all other practitioners, physiotherapists, respiratory therapists, pharmacists and dietitians, serve the entire hospital.
Physician Model of Care	Doctor of the day, may change frequently throughout the week.	Intensivist covers the ICU for a full week.
Composition of Rounds	Physician-only rounds occur every day; grand rounds once per week.	Interdisciplinary rounds every day.

Physical layout. Site A was built in 2011 and contains 10 patient rooms (Appendix I). There are two main hallways in the unit, with six ICU beds located along one hallway, and four cardiac care beds are located along a parallel hallway. The hallways contain central monitors showing the vital signs, invasive monitoring parameters and cardiac rhythms for all patients. Between the patient rooms are common areas including the medication room, nursing station, unit clerk station, clean and dirty utility areas, kitchen, and the "fishbowl" where allied health staff and physicians can access computers. The family waiting area is located outside of the unit. All patient rooms are large, modern, private rooms. The rooms contain an ICU bed, boom for supporting equipment, cardiac monitoring, and room for additional equipment such as mechanical ventilators and dialysis machines. The unit has a distributed model of nursing care, with nursing workstations located between patient rooms. Nurses are able to view two patients at a time from the workstation. At each workstation there is a phone and computer. See Figures 4.1 and 4.2 for patient room and workstation layout.

Site B was also built in 2011. It has 17 patient rooms to care for 11 ICU patients, 2 CCU (Cardiac Care Unit) patients and 4 'step down' patients, though the numbers of each type of patient varies from day to day. The patients are co-located throughout the unit, which is an "E" shape (Appendix J), with 5 beds along the spine of the unit, and 4 beds in each of 3 pods. The unit clerk station and team room are located near the entrance to the unit. Clean utility and equipment areas are located at each end of the unit, and the dirty utility is centrally located. The medication room is located near Pod 3 at the opposite end of the unit from the unit clerk station. Patient monitors can be viewed from central locations within the main hallway and in the pods. Like Site A ICU, all patient rooms are large, modern, and private. The unit also has a distributed

model of nursing care, with nursing workstations located between patient rooms. At each workstation there is a phone and computer.



Figure 4.1: Layout of a patient room in Site A ICU (Zone 1), including bed, two booms, cardiac monitoring, and equipment cart. ICU rooms at Site B are a similar size and contain similar equipment.



Figure 4.2: A nursing workstation (Zone 2) in Site A ICU, with cardiac monitor, phone and computer. Workstations at Site B ICU have a similar layout.

Patient population and nursing assignments. At Site A, ICU day shifts ran from 0700 to 1900, night shifts from 1900 to 0700. The ICU had a unit clerk on day shift and a patient care coordinator for eight hours per day, five days per week. When the unit was fully staffed on a day or night shift, there were six critical care RNs in the unit. Four or five nurses cared for ICU patients, and one or two nurses cared for cardiac patients, depending on patient acuity. In addition, there was a critical care RN on staff from 0800 to 2000. Nurses caring for ICU patients, cared for one or two patients, depending on staffing levels and patient acuity.

At Site B ICU, day shifts ran from 0730-1930, night shifts from. The unit had a unit clerk on day shift and a patient care coordinator on day shift for 12 hours, 7 days a week. When the

unit was fully staffed, there were 13 critical care RNs in the unit, but this varied widely given years of high patient acuity, and recent staff shortages. Nurses there usually cared for one to two patients, but sometimes cared for three patients in rare circumstances.

The overall patient acuity was higher at Site B than Site A, as is expected for a tertiary ICU. This was the case during observations and was demonstrated by a greater percentage of patients receiving mechanical ventilation and inotropes and vasopressors for blood pressure support. For instance, during all four observations days at Site A, one patient being cared for by a participating nurse was mechanically ventilated, and their maximum norepinephrine dose was 26 mcg/min. At Site B, four (out of seven) patients being cared for by participating nurses were mechanically ventilated, and the maximum norepinephrine dose a patient received was 110 mcg/min.

Composition interdisciplinary team. At Site A, ICU nurses had access to allied health and support services, however, these support staff served other units in addition to ICU. For instance, the physiotherapist, respiratory therapist and educator that support ICU also have duties elsewhere. At Site B, there were a greater number of allied health and other support personnel assigned exclusively to ICU patients. There were two dedicated respiratory therapists, a physiotherapist, rehabilitation assistant, and a full time clinical nurse educator.

Physician model of care and composition of rounds. At Site A ICU, day or night, there is a designated "ICU Doctor of the Day" who is responsible for admitting ICU patients and managing patient care for a 24-hour period until that doctor hands care over to the next doctor of the day. Daily rounds occur between the most responsible physician and RN, typically between 9am and 11 am in the morning, however as one RN stated "this is variable. Sometimes rounds are early, sometimes they are late. Late is bad." There is no tradition of daily interdisciplinary rounds in

Site A ICU, however, once per week grand rounds takes place in the ICU. According to Site A nurses, these rounds involve ICU physicians, residents, medical students, consultants, nurses and allied health and are very physician focused. Grand rounds did not take place on the days that I conducted observations.

At Site B there is a designated ICU Intensivist who is responsible for admitting and managing patients until he or she hands over care to the next intensivist. Daily interdisciplinary rounds take place at approximately 9-11 am, and include the MD, RN, dietician, respiratory therapist and pharmacist at a minimum, but also included a physiotherapist, social worker, medical students, RN students, and consultants. Participating RNs at Site B report that rounds do occur on weekends, but are "less formal" than on weekdays.

Sources of information. Both ICUs were information-rich environments. Every shift, nurses received information from, and made sense of, information from a huge number of sources. Appendix K provides a catalogue of information sources that nurses used during observation days. This list is not comprehensive; there are many types of equipment and information available to use for patient care that were not used during my observations days. Nurses are aware of the location and contents of a huge variety of information sources, when the need for them arises. Appendix L provides a visual example of the forms and patient education pamphlets that ICU nurses fill out or teach from.

Nurse Participants, Patients and ICU on Observation Days

At each site, I recruited four nurse volunteers for the study. At Site A, I conducted 8 hour observations and informal interviews from 0700-1500 on September 8, 11, 16 and 22, 2018. At Site B, I conducted 8 hour observations and informal interviews from 0730-1530 on October 11, 12, 15 and 16, 2018. At both sites, the observation days varied markedly with respect to the

workload and overall busyness and acuity of the units. For example, at Site A, on a low acuity day the observed RN, cared for one patient, who was awaiting discharge home and the unit was well below 100% capacity. This contrasted sharply with the next observation day, when the study RN took on the charge nurse role and cared for a patient on vasopressors, while the unit itself was at 100% capacity and had a high patient acuity. In Site B, the nurse participants' responsibilities and unit busyness also varied, but was on average busier, with heavier workloads, than on Site A observation days. A brief summary of the characteristics of the nursing workload and the ICU on those days is provided in Table 4.2.

This Space Intentionally Left Blank

Table 4.2. Nursing and unit context on observation days. Nurses and patients in Site A were coded with a "V". Therefore, VN1 refers to Site A Nurse 1, while VP1 refers to Site A Patient 1. Nurses and patients at Site B were coded with an "R".

Date	Unit/Nurse	Nursing Role & Responsibilities	Unit Context
Sept 8	Site A /VN1	RN caring for VP1, a stable patient who had received abdominal surgery the night before.	'Bustling' but fully staffed.
Sept 11	Site A /VN2	Caring for VP2, a stable patient with a diagnosis of alcoholism and liver disease waiting for discharge home .	Quiet, unit fully staffed with one open bed.
Sept 16	Site A /VN3	Caring for VP3, patient in septic shock who required optiflow, norepinephrine and amiodarone. Charge nurse for the unit.	Incredibly busy. Down one RN and missing a unit clerk, with higher than normal acuity.
Sep 22	Site A /VN4	Caring for VP4, a patient in third degree heart block, requiring isoproterenol infusion.	'Bustling' but fully staffed.
Oct 11	Site B /RN1	Caring for RP1, a patient recovering from a head injury, and RP2, a patient recovering from respiratory failure and needing interventional radiology insertion of a drain.	Extremely busy unit, short staffed with multiple Code Blues called and MRP in ED trauma room for part of shift.
Oct 12	Site B /RN2	Caring for RP3, a patient with liver and kidney failure requiring dialysis, norepinephrine and pressure-controlled ventilation; Caring for RP4, a patient in persistent ventricular tachycardia and respiratory failure, requiring pressure control ventilation, norepinephrine and inotropes; Supervising student.	Extremely busy unit, short staffed.
Oct 15	Site B /RN3	Caring for RP 5 a step down patient with exacerbation of COPD, requiring BiPap and optiflow; Caring for RP6 a patient who had received neurosurgery for a subdural bleed, who required mechanical ventilation and an EEG.	Extremely busy unit, short staffed.
Oct 16	Site B /RN4	Caring for RP 7, a patient requiring mechanical ventilation but being weaned off of vasopressors; supervising student.	Fully staffed, busy but controlled unit.

Information Unique to Critical Care RNs

In both Site A and Site B ICUs, RNs were often the first healthcare providers to become aware of three types of information: *Patient Status Changes, Patient and Family Care Wishes,*

and the *Plan of Care*. They receive this information through: 1) direct patient assessment and care, 2) conversations with patients and families, 3) handover reports from other RNs, as well as, 4) by being the first care provider to read laboratory results, and diagnostic imaging reports. I condense and discuss these types of information below. See Figure 4.3 for a summary of all results.

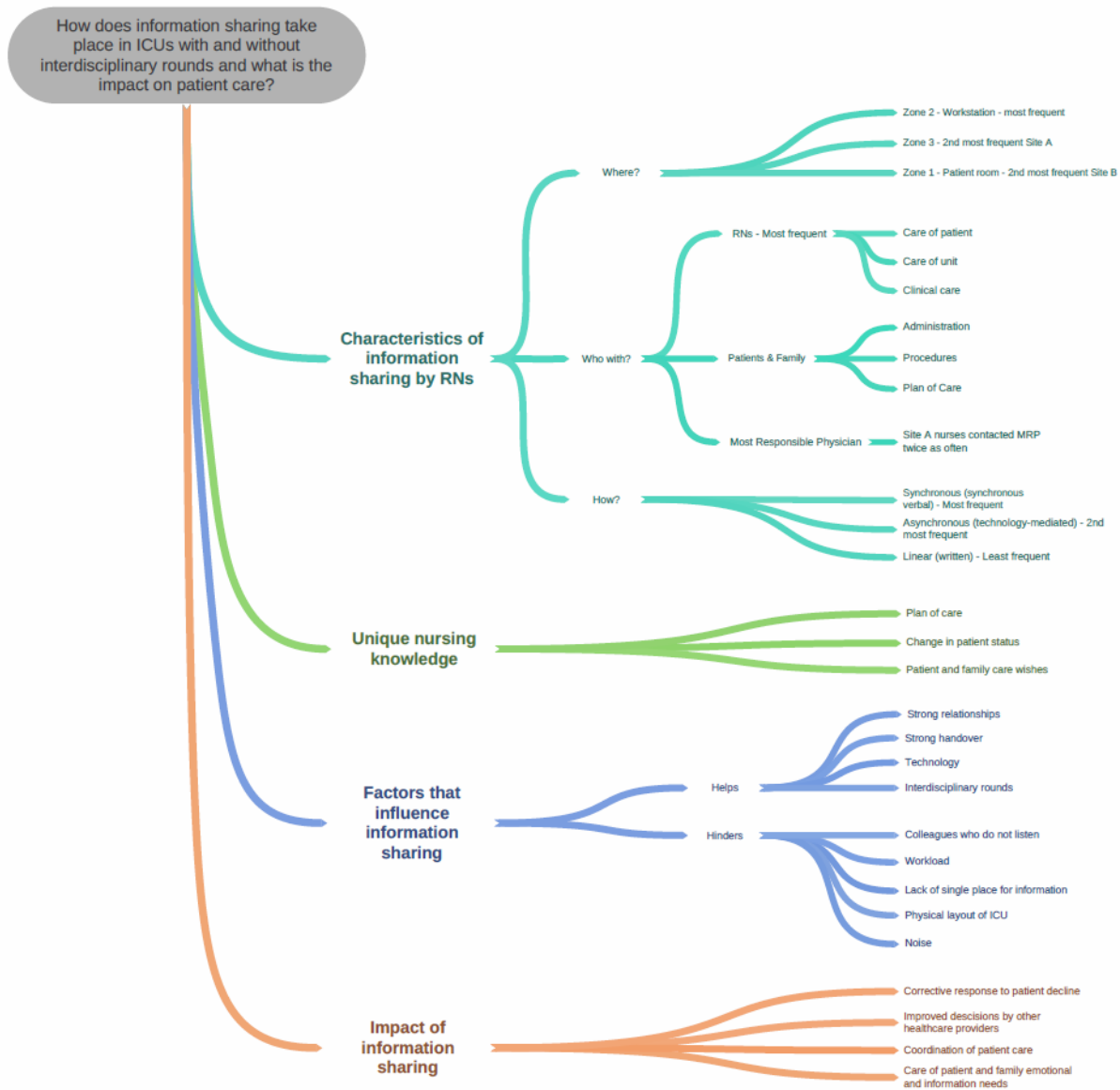


Figure 4.3 Mind map illustration of the study results.

Changes in patient status. Critical care RNs in both ICUs were the first care providers to become aware of changes in patient status. Patient status and changes included improvement or deterioration in signs and symptoms, such as physical assessment parameters, and patient response to medications, treatments and procedures. RNs became aware of these changes through repeated physical assessments that involved asking questions, visual assessment, auscultation, palpation, inspection of cardiac rhythms, and reviewing input and output data. Some of these assessments were complex and require clinical decision support, such as assessing for delirium or pain in patients who could not speak. While other practitioners performed assessments, for example, respiratory therapists performed thorough respiratory assessments, and physiotherapists assessed mobility, no other practitioners were observed to conduct assessments as comprehensively or as often as the RNs, and this was consistent across all RNs in both ICUs.

A clear example of RNs being the first to notice a change in patient status occurred when VN4 was mobilizing her patient, VP4, and noticed a sudden change in heart rhythm from normal sinus rhythm to third degree heart block. The RN then reported this change in heart rhythm during mobility to the physician and the physiotherapist. Likewise, RN2 and an RN student, were the first to notice a sudden drop in RP3's hemoglobin overnight, and they certainly were the first to identify the cause in the drop. On noticing the drop in hemoglobin, RN2 instantly suspected a GI bleed, because he knew that the patient's underlying diagnosis was liver failure. He instructed the RN student to check RP3's nasogastric returns and immediately returned frank red blood.

Critical care RNs were almost always present during diagnostic tests or procedures, and therefore were among the first to know both the results of the treatment or test and a patient's tolerance of the test. For instance, RN1 accompanied RP2 down to interventional radiology for a

drain insertion. She comforted her patient and observed that he tolerated the treatment comfortably. In another example, RN4 was the first to learn that RP7's blood cultures returned *Streptococcus mitis*, a lab result that confirmed that her patient's sepsis was caused by endocarditis.

Patient and family care wishes. At both Site A and Site B, nurses were often the first to learn about patient and family wishes for care. The care wishes expressed to nurses included the type of nursing care they wished to receive, how they preferred to be communicated with, psychosocial needs, and the scope of medical care.

If patients or families had psychosocial needs, whether they were expressed by the patients or families or not, nurses were often the first to know. Nurses would either address the concerns themselves, or contact the social worker or aboriginal patient navigator to connect them with the patient and family. Finally, in the patients and families observed, when they were ready to speak with the physician about a change in medical treatment, often a de-escalation of care, they spoke to the RN first. For instance, VN3 was first to learn from the patient and family that the patient wished to let "nature take its course".

Plan of care. At both Site A and Site B, nurses were aware of the overarching plan of care for their patients, integrating their own nursing care plans with the plans of other healthcare providers. At Site A, this global plan of care information appeared unique to the RNs as different practitioners independently spoke to RNs, and RNs then shared this with other practitioners. For instance, VN1 shared the physician's orders for mobility with the physiotherapist, and shared respiratory therapists' assessment of improving patient status and plan to deescalate respiratory care with the physician. The nurses at Site B played a lesser role in communicating the plan of care to other practitioners, though when plans of care were updated outside of rounds, nurses

were often the first to know and played a role in communicating the change to other providers as needed. For example, RN3 relayed the neurosurgeon's assessment findings and order of an EEG to the MRP and care team at rounds.

Information Sharing by RNs

People with whom RNs shared information

RNs shared information with patients, family members, fellow registered nurses and other health care professionals (see Table 4.3 for a comprehensive list; see Appendix M for counts of information sharing with patients, families and other healthcare providers). Overall, there was very little difference between the types of information shared by RNs, and the people they shared it with, in the two ICUs.

By simple count, RNs in both ICUs shared information most frequently with other RN's. These interactions ranged from detailed, rich discussions of patient history, recent events and current patient status, to quick utilitarian answers to questions or handover reports when nurses returned from breaks. The information they shared with other RNs are broadly categorized as clinical practice, care of the patient and care of the unit. Nurses often relied on each other as sources of information for advanced clinical practice. In one example, VN3 provided information to one RN on intra-osseous device removal and targeted temperature management. They also shared detailed information on patient care during patient handover, and while assisting each other with patient care. Finally, nurses routinely discussed admissions and discharges, staffing, and how to organize break relief, all of which is essential to smooth functioning of the unit.

Nurses in both units shared information almost as frequently with their patients as they did with other RNs, though the frequency of information sharing varied with the patient's neurological status. For instance, patients with a Glasgow Coma Scale of 3 and no discernable

neurological function, or with deep sedation, were spoken to only when patient care was being described. On the other hand, lively conversations were held with neurologically intact patients. The information that they shared with their patients included information about family, the plan of care, and descriptions of procedures and other aspects of patient care. Information sharing with patients often occurred in the context of providing care or conducting an assessment. VN3, for example, would keep the patient apprised of the expected time of arrival of family members, and also described how she would carry out the plan to switch from critical care interventions to comfort care. Likewise, RN3 described the process of the EEG diagnostic test to her patient even though he was partially sedated.

Nurses in both units also shared information third most frequently with the family members of patients. They provided family members with information on patient status, the plan of care, and administrative things like parking and visiting hours. One of the most valuable forms of information sharing that critical care nurses in both units provided to family members was guidance on withdrawal of life-sustaining treatment for their loved ones. Both VN3 and RN2 played this role in conversations with family members.

In both ICUs, nurses shared information fourth most frequently with the most responsible physician (MRP). In both units, RNs spoke with the MRP every day. In Site A, however, nurses interacted with the physicians twice as often as the nurses in Site B. In both cases, nurses shared information on patient assessment findings, changes in patient status, and response to treatment in rounds and in one-to-one encounters or family conferences. The nurse who had the most frequent encounters with the most responsible physician was VN4. In addition to rounds, VN4 phoned the MD seven times regarding VP4's change in heart rhythm and rate from normal sinus

rhythm at 60 beats per minute, to third degree heart block at 35 beats per minute. VN4 shared the change in status with the MD and obtained orders for medication titration and mobility.

RNs at Site B interacted with the MRP primarily during rounds, and had fewer total discussions with physicians even though 3 of the four Site B RNs cared for two patients at a time while all Site A RNs cared for one patient each. At Site B, RN2 had the most frequent interactions with the MRP; a total of six separate encounters, discussing RP3 and RP4 each three times. However, four of the six times in which RN2 interacted with the MRP, the MRP approached RN2 (in contrast to the RN seeking the MRP's attention).

Another difference between the people that RNs shared information with at Site A and Site B were representatives of allied health. At Site A, for instance, two RNs shared information with the respiratory therapist and physiotherapist, and one RN interacted with the dietitian and pharmacy technician. In contrast, all RNs at Site B shared information with respiratory therapists, pharmacists, dietitians and social workers.

Other information sharing by RNs occurred with charge nurses or patient care coordinators, diagnostic imaging technicians, physician consultants, and laboratory technicians. There was no observed meaningful difference in the type of information sharing with these practitioners at Site A or Site B. Results are summarized in Table 4.3.

Table 4.3: People with whom study nurses shared information

Person	Comment
Registered Nurse	Study RNs shared information most frequently with other RNs and primarily discussed clinical practice, care of the patient, and care of the unit.
Patients	Study RNs shared information frequently with patients, about family presence, plan of care, and current care. Frequency and depth of information sharing depended on patient neurological status.
Family members	Family members were the people third most frequently interacted with. Nurses shared information about patient status, plan of care, current care, and miscellaneous items such as ICU procedures and parking.
Most Responsible Physicians	Site A RNs shared information with the MRP twice as often as Site B RNs. For both sites, one encounter per day took place during rounds. Nurses in both ICUs shared information about patient assessments, patient changes, and response to treatment and patient and family desires for care.
Allied Health Representatives	Information sharing with allied health staff occurred more frequently at Site B than Site A and often took place during rounds.
Unit Clerk	Information sharing about order processing.
Patient care coordinator	Information sharing about patient status, and likelihood of patient discharge.
Consultants	Nurses in both ICUs shared information about patient assessments, patient changes, response to treatment
Diagnostic Imaging	Coordination of test times and preparation.
Laboratory Technicians	Urgent need for laboratory test.

How information was exchanged. In both ICU's most information sharing by RNs took place by synchronous verbal exchange with others. At Site A, participating nurses had between 27 and 97 distinct, synchronous verbal exchanges, and at Site B, nurses had 48 to 74 distinct verbal exchanges (Table 4.4). This communication ranged from rapid, functional exchanges between nurses, to perform independent double checks of medications, to longer, deeper exchanges with patients and families to collect medical histories. In addition to this verbal exchange, some of this synchronous information exchange was non-verbal, as was the case with

RN2 who would observe the patient's room, gather pamphlets, and offer chairs to grieving family members without either needing to speak.

Asynchronous information exchange, including phone calls, Vocera calls, faxes and text exchanges, occurred much less frequently. At Site A, nurses engaged in asynchronous information exchange between two and 15 times per observation shift, and at Site B these exchanges occurred between five and 15 times per 8-hour period. At Site A, asynchronous information exchange occurred most frequently by phone, sometimes with the physician, but also to answer family questions. At Site B, these exchanges occurred most frequently via Vocera, usually for the purpose of calling the respiratory therapist or the care aide to the room to help with patient care.

Linear information exchange occurred eight to 19 times at Site A and between four and 32 times at Site B. The majority of this linear information exchange occurred in both units when nurses documented patient care and status on their primary nursing documentation, the critical care flowsheet at Site A and the critical care record at Site B. Linear information exchanges also included documentation on the MAR, the transfusion record, kardex, plan of care, and a variety of other forms.

A review of nursing documentation revealed very little difference between observations and participant nursing interpretations of activities and care. Nurses succinctly documented patient status, patient care, conversations with patients, families and other healthcare providers, providing a comprehensive picture of patient care and patient status.

Table 4.4: Counts of synchronous, asynchronous, and linear information sharing. Findings over an eight-hour period. Grey rows indicate nurses in Site A, white rows indicate nurses at Site B.

	Synchronous	Asynchronous	Linear
VN1	53	2	14
VN2	27	2	7
VN3	97	14	17
VN4	49	15	16
RN1	71	15	32
RN2	74	9	16
RN3	48	6	27
RN4	73	5	4

Location of information exchange. Once again, there was little different in the two study sites with respect to the location of information exchange (see Table 4.5 for a breakdown of where each nurse shared information). In both ICU's, nurses spent the most time in Zone 2, their workstation. Time spent at the workstation ranged from 23% to 65% of the observation period. At the workstation, nurses spent time in all types of information exchange interactions. They had lengthy care planning discussions with colleagues, conducted phone calls with family members, coordinated care with radiology or lab, and did almost all of their documentation there.

In Site A, nurses spent the next largest amount of time in Zone 3. They spent approximately 31 to 38% of their day, in Zone 3. Areas with particularly high use and information sharing included the medication room, nursing station, and unit clerk station. In the medication room, information exchanges revolved around medications, such as independent double checks of medications, and discussions of the stock levels of isoproterenol in the automated dispensing cabinet. In unit clerk stations, nurses scanned orders to pharmacy, clarified orders with the unit clerk, and answered questions about whether visitors were or were not allowed in the unit. In the nursing station, unit huddles took place during which nurses discussed

the status of the hospital and the ICU, pending admissions and discharges, and the status of unit-wide quality improvement initiatives.

In contrast, nurses at Site B spent on average much less time in Zone 3, with the time spent ranging from approximately 2% to 32%. Areas of heaviest information sharing were the team room, to take part in the team huddle, the medication room, and workstations where they watched patients who were assigned to other nurses. RN4, who spent about 32% of her time in Zone 3, was supervising an RN student who was nearly independent with ICU patient care.

At Site A, nurses spent approximately 15% to 36% in the patient's room, Zone 1. In Zone 1, nurses performed assessments and delivered patient care, and conducted most conversations with patients and families. They gathered information from the patient and family, and also provided information, particularly regarding the immediate plan of care, and new orders from the physician. At Site B, the percentage of time spent in patient rooms was slightly higher than at Site A. Nurses spent 12% to 45% of their time in their patient's rooms. RN4, who was supervising an independent student, spent the least amount of time in her patient's room, at 12%.

In both ICUs, most nurses spent between 0 and 10% of their time in other patient's rooms. RNs either assisted with patient care, such as turns, or mobility, or provided consultations on equipment when they were in other patient rooms. Nurses also spent minimal time in Zone 5, outside of the ICU. When they did, they were either speaking with family in the family waiting area, or transporting patients down to the imaging department. See Figure 4.3 for a summary of the characteristics of information sharing.

Table 4.5. Percentage of time nurses spent sharing information in each ICU 'Zone'.

Study RN	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
VN1	36%	34%	30%	0	0
VN2	15%	52%	31%	2%	0
VN3	22%	23%	38%	10%	6%
VN4	21%	43%	31%	5%	0
RN1	34%	40%	10%	5%	15%
RN2	28%	65%	7%	0	0
RN3	45%	52%	2%	1%	0
RN4	12%	29%	32%	27%	0

The Impact of Nurse Information Sharing on Patient Care

Information sharing by critical care RNs influenced patient care in a variety of ways. I have categorized different impacts as: 1) corrective response to declining patient condition, 2) coordination of patient care, 3) improved decision making by other care providers, and 4) care of patient and family informational and emotional needs. There was no obvious difference in the impact of information sharing by RNs in the different units, and examples of each of the four categories occurred in both units. See Figure 4.3 for a summary of results.

Corrective response to patient decline. Critical care RNs were usually the first to know when a patient's condition had deteriorated. For example, when VN1's patient had persistent low blood pressure in spite of multiple fluid boluses, she continued to reassess her patient's blood pressure, urine output, respiratory status and fluid balance, and then updated the most responsible physician to obtain new orders to treat the patient's hypotension.

Coordination of care. Critical care RNs play a central role in care coordination, particularly when care plans are delayed, or patients do not respond to care as anticipated. For example, RN1 cared for a patient who required the insertion of a drain under CT imaging, however, this patient was at high risk of hemorrhaging because his INR was too high. The patient required four units

of fresh frozen plasma to correct the INR, but the imaging department bumped up his scheduled drain insertion time. To ensure that the patient could safely have his procedure, RN1 had to administer the fresh frozen plasma quickly, coordinate the lab to conduct early lab draws, obtain an order to permit the drain insertion to go ahead regardless of whether the results of the INR came back, reschedule assistance with the respiratory therapist and porter for transport, and negotiate with the imaging department for a slightly later time.

Improved decision making by other care providers. Information sharing by RN's during interdisciplinary rounds, or in individual conversations by other providers, led to faster, better decisions by other healthcare providers. For instance, when VN4 learned that her patient's blood cultures had grown *Streptococcus mitis*, she sped up the diagnosis and treatment of endocarditis for her patient by immediately relaying this information to the physician. Likewise, when VN4 described her patient's response to mobilizing to the physiotherapist, namely that the patient's heart rhythm had changed to third degree heart block and the patient became delirious, the physiotherapist could adjust physiotherapy treatment for that patient without repeating the experience.

Care of patient and family emotional and information needs. RNs shared information directly with patients and families to satisfy information and emotional needs. All RNs explained procedures, patients care and assessments to patients and families while they were happening, even when patients did not ask what was happening. VN2 provided her patient and patient's mother with discharge instructions, for instance. RN1 explained the interventional CT procedure to her patient while it was happening, and RN3 explained the EEG procedure to her patient as it happened. Then, they repeated these explanations when they saw their patients' families. They

assumed that patients and families wanted to know, and they were not asked to stop explaining these things.

Factors that Influence Information Sharing by Nurses

There was no clear difference between Site B and Site A nurses with respect to their beliefs about the factors that improve and impair information sharing. While interdisciplinary rounds were identified as a factor that facilitated communication, only one nurse identified it as the most important factor influencing information sharing for nurses. I summarize the factors that influence information sharing below and in Figure 4.3.

Factors that improve information sharing. *Strong relationships between colleagues.*

Nurses expressed that the key factors improving information sharing were trust and a positive relationship. Nurses stated that one thing they found challenging about periods of high staff turnover, was the time it took to get to know colleagues, understand their work habits, and develop the strong bonds needed to facilitate the rapid communication required in the ICU setting. The presence of trust and close relationships between staff was confirmed by observations in both ICUs of nurses expressing positive regard toward each other with body language that included smiling at each other, standing close to each other while chatting, and asking about each other's personal lives.

Strong handover communication. Nurses stated that a strong handover at the beginning of the shift helped them to understand their patient's history, current status and plan of care. This in turn improved their ability to share information with others early on in the shift. According to the nurses, a strong handover included a paper and verbal report, an organized structure to the report, and a lack of interruptions. Two nurses stated that they liked to conduct report at the

patient's bedside so that they could observe that patient's physical status, infusions, ventilator settings, wounds and drains while they were being described by the off-going nurse.

Most of the handover communication that I observed was highly organized and systematic, but there were two instances, both at Site A, where participating nurses felt that handover was insufficient. In one instance, the off-going RN provided a quick and superficial report prior to leaving, omitting crucial details like the history of presenting illness. In the other, the off-going nurse was the charge nurse on an extremely busy night shift and was being interrupted with questions continuously while she attempted to give report. Nurses felt that poor handover communication put them "behind" in the shift, and made it awkward to answer questions from family and other care providers.

Interdisciplinary rounds. Six out of eight nurses indicated that interdisciplinary rounds were helpful in improving communication between themselves and other health professionals. They stated that it helped them provide the same message to a variety of colleagues at once, and, just as importantly, helped them understand their non-nursing colleague's thought processes and plans of care for the patient. They stated that this helped them to provide a consistent message to the patient and family. However, even the nurses who were supportive of participating in interdisciplinary rounds stated that it could be stressful to prepare for them. They did not always have the time to perform a thorough assessment and documentation prior to rounds, which required them to give a report on their patient's status that was incomplete.

I observed that the role of the RN in interdisciplinary rounds at Site B was central to rounds. They provided a review of overnight activities and a current state assessment that was essential to the decision making by other team members. I also observed that when nurses are

extremely busy, as RN1 and RN2 were prior to rounds, it was challenging to provide an adequate report.

Technology. Vocera was identified as a useful, relatively new technology that was implemented specifically to facilitate communication and information sharing. Nurses in both ICUs noted that the ability to contact respiratory therapy during a patient crisis, without having to leave the patient's bedside, was an important advancement in communication. Vocera also facilitated communication between charge nurses in different wards, and allowed nurses to request assistance of care aids and other care providers while in isolation rooms. In both ICU's, and particularly in Site A, not all nurses signed into the Vocera system, making it less useful than it could be.

Factors that impede information sharing by nurses. *Lack of a single location for information.* Seven out of eight of the nurses identified that a lack of a central place to store all information impaired their ability to receive and share information. Nurses pointed to admission history, plans of care, critical care documentation, and kardexes to make their point. In addition to these forms, I collected a single copy of all of the documentation forms and patient information pamphlets at Site A to gain an appreciation of all of the different forms and information documents that nurses needed to locate, understand, and distribute as appropriate. The stack of forms included different forms for basic and advanced restraint use, falls risk, Braden scale, pediatric assessment forms (six different forms, depending on the child's age), information on cardiac procedures, stroke and much more. The information documented on these forms had to be combined with the information located in the MEDITECH electronic record, paper print outs of labs and radiology reports that are available in the EHR, and sticky notes that

nurses used to remind each other and themselves of pending procedures or care that patients required.

Not only are there multiple different, slightly overlapping forms for nurses to use, there was inconsistent practice for how they were used. Some nurses used plan of care to summarize the events of the day and plan care. Other nurses, particularly in Site B, preferred to use the kardex. The inconsistent use of these tools, which on their own are intended to provide a single place to summarize patient care, led to difficulty in using the documentation to find the patient's "whole story".

Physical layout of the ICU. Nurses at both ICUs identified the linear layout of the ICU as a factor impeding information sharing by nurses. Nurses in both ICUs stated that in the old ICUs in each facility, patients surrounded a central nursing station. With this design, all patients were visible from the nursing station, and it was very easy to see if a colleague was extremely busy, and therefore lend a hand. With the linear nature of the new ICU designs, and in particular Site B's pod design, nurses had become isolated from each other, and teamwork was less common. As well, nurses found it difficult to know what was going on in the entire unit, and had come to focus on just their patients, or the patients in their assigned pod.

Workload. Heavy workloads were identified by RNs to be impediments to information sharing. VN2 received a scattered and incomplete report from a charge nurse who had a heavy patient load on a night shift due to short staffing. RN2 also received a poor handover report for his two very high acuity patients because the night shift staff had been unable to write report and were still providing patient care during shift change. And RN1 was unable to spend much time with RP1 at all in the first half of her shift because she was so busy preparing RP2 for his procedure. Nurses felt frustrated when these communication gaps happened, but did not place

blame on their colleagues. They stated that staff shortages and increasing patient acuity were largely to blame for these communication gaps.

Colleagues who do not listen. In Site A, three of the nurses identified "colleagues who don't listen" as an impediment to information sharing. Specifically, they were speaking about attempts to communicate patient status and assessments to physicians. I observed this interaction on one occasion, in which the study nurse was repeatedly interrupted by the physician while trying to provide report. Nurses spoke about 'tricks' that they would use to 'get what they wanted' from their physician colleagues, which included asking another physician first if an order for analgesia was a good idea, and then presenting the idea to the ordering physician as though it came from the physician colleague. At Site B, nurses did not identify "colleagues who did not listen" as a hurdle to information sharing.

Noise. Only two nurses identified noise as an impediment to information sharing, however, observations during busy, noisy days in both ICUs clearly point to noise interfering with communication. During one shift at Site B ICU, a Code Blue was repeatedly called overhead, impairing RN1's ability to communicate with the physiotherapist. On another shift, there were so many care providers in Pod 1 during rounds that chatter between professionals made it difficult for RN4 to hear what was being said between her student and the physician.

Chapter 5 - Discussion

In this chapter, I discuss the original research questions for this study in light of the study results and current research and theory on interdisciplinary rounds and situation awareness.

Then, I demonstrate how the findings from this study support and extend the model of distributed situation awareness developed by Stanton and others (Salmon et al., 2017; Stanton et al., 2017; Stanton et al., 2006). Finally, I describe the significance and limitations of the study, and present a series of recommendations for practice and future research.

The purpose of this study was to investigate how information sharing takes place in ICUs with and without daily interdisciplinary rounds, and how this information sharing impacts patient care. Specifically, I explored four questions: 1) What patient and family-specific information is generated by, and unique to, ICU nurses? 2) How, where, and with whom is information shared with other members of the healthcare team? 3) What is the impact of nurse information sharing on patient care? 4) What factors influence information sharing by nurses?

The key finding of this study is that there was very little difference in information sharing by nurses in the two study ICUs. Specifically, nurses' unique information, the characteristics of information sharing, the impact of information sharing, and the factors that influenced information sharing were very similar between ICUs. One possible difference between the units was that nurses at Site A contacted physicians twice as often as nurses at Site B, which may stem from the fact that Site A does not use predictable interdisciplinary rounds.

The results of this study of information sharing support and extend the model of DSA. The data presented here augmented the model in two useful ways; first, by identifying how SA transactions occur, and second by exploring the impact that DSA has on individual and team goals.

Q1 - Information Unique to Nursing

This study revealed the same three categories of unique nursing knowledge in both ICUs. Nursing knowledge is the product of the nursing role, the socio-technical system, and the physical environment. A key nursing role in ICU and other environments is to recognize and address changes in patients' physiological and behavioural status, and to communicate those changes if necessary. This work is supported by both a technical system that includes extensive monitoring equipment, and staffing levels that permit a nurse to care for one or two patients. Researchers have suggested that DSA is lower in ICUs with strained capacity (Bagshaw et al., 2017), and this was evident in one example where an RN with an exceptionally high workload knew less about one of her patients than her colleagues did. This also shows, as Stanton and others suggest, that at least for a period of time, colleagues can make up for information that is lost by a team member (Stanton et al., 2017). Nursing knowledge contributes to DSA when nurses share it with team members. The factors that influence nurses' ability to gather and share this information, have all been identified by Stanton et al. in the model of DSA (Salmon et al., 2017; Stanton, 2016; Stanton et al., 2017; Stanton et al., 2006, see Figure 5.1, Figure 5.2 and accompanying discussion).

In the course of a patient's stay in ICU, patient and family care wishes can change, particularly if the patient's condition deteriorates, and nurses are often the first to be aware of these changes. The extended time that nurses spend with patients and families promotes trust, and enables them to be available when care decisions are made. Previous studies have noted that ICU nurses play an important role as liaisons between the patient and family during the patient's end of life (Adams, Bailey, Anderson, & Docherty, 2011).

Finally, at both sites, nurses played an important role as the focal point of communication, by receiving and distributing information to and from other providers. Even when plans of care were developed during interdisciplinary rounds, patient status changed rapidly enough that care plans changed more than once per day. Nurses were often the first to be aware of these changes.

Q2 - How, Where, Why and With Whom Information Is Shared

The presence of interdisciplinary rounds did not influence the patterns of information sharing by nurses, with the possible exception of the frequency with which nurses contacted physicians. Nurses in both ICUs interacted most frequently with other nurses, which demonstrates the extent to which nurses rely on each other to maintain smooth running of the ICU, to take care of patients when staff retire for breaks, and to take care of each other.

The pattern of nurses communicating at high rates with other nurses has been noted previously in studies of social communication networks. In one study of communication in a burn unit, authors noted high levels of "homophily" (communication between members of the same profession) between nurses. Nurses were 1.64 times more likely to communicate with nurses than with other members of the interprofessional team (Shoham, Harris, Mundt, & McGaghie, 2016). In another study of communication networks in an emergency department, members of nursing and medical professions both interacted within professions more frequently than between them (Creswick, Westbrook, & Braithwaite, 2009). However, both of these studies were conducted indirectly through interviews and surveys, and in neither study was the content of nursing interactions explored. While these types of social network analyses are relatively new in nursing research (Benton, Pérez-Raya, Fernández-Fernández, & González-Jurado, 2015), they may contribute to our understanding of the how DSA arises in healthcare settings.

There was a difference between nurses in the two ICUs with respect to sharing information with physicians. This may be related to the long standing practice of interdisciplinary rounds in Site B. Nurses at Site B knew that they would have an opportunity to discuss their patients at length with the physician at least once every shift, which may have given them confidence to wait to speak to the physician about patient care matters until this time. In contrast, the nurses at Site A did not know when the physician would arrive, and did not know how long rounds would take, so they may have been less comfortable waiting to contact the physician about patient care matters. I did not find any literature to support this contention, and this pattern of contacting physicians may be the result of individual practice differences between the nurses in this small observational study, but it would be interesting to understand whether the implementation of nurse-integrated interdisciplinary rounds decreases the number of calls physicians receive from nurses.

Nurses at Site B interacted with members of social work, allied health and pharmacy professions more often than nurses at Site A. This may in part be because interdisciplinary rounds offered them the opportunity to connect with members of these professions on a daily basis. However, Site B ICU is also in tertiary center with a greater number of support services than Site A.

Q2 (a) - How information is shared in ICU. There were no discernable differences between the ICUs with respect to the ways in which nurses shared information. The reliance of nurses in both ICUs on the immediate information transfer afforded by synchronous and asynchronous communication has implications for DSA in the ICU setting. In theory, interdisciplinary team members could read nursing documentation during rounds to obtain nurse-generated information on patient status, and nurses could simply read physician orders and

physiotherapist documentation to understand their colleagues' plans of care for the patient. However, numerous studies of communication, both within rounds and outside of it, have shown that verbal communication is far superior to written communication with respect to completeness, prioritization, and impact on patient safety (Abraham, Kannampallil, & Patel, 2014; Clark et al., 2019; Lane et al., 2013; Mullen et al., 2019; Ten Have et al., 2013). The majority of the contribution that nurses make to DSA in the ICU is through these verbal interactions. Documentation provides an important source of trending information, and is a valuable record of patient care, but its contribution to DSA in the moment is limited.

Q2 (b)- Where information is shared in ICU. As expected, nurses at both sites spent a high percentage of time sharing information in Zone 1, patient rooms. Here, nurses shared information with patients and families, and generated almost all of the patient-specific information that was unique to nursing, through care, assessments and conversations. This location was a high source of the patient-specific nursing information that contributed to DSA in the ICU.

In Zone 3, by contrast, conversations centered on unit coordination and management of nursing breaks. These encounters were important sources of information for how nurses on the unit were coping as a whole. It broadened their awareness to encompass the entire unit, including their colleagues and other patients, and therefore were important contributors to DSA.

Q3 - The Impact of Nurse Information Sharing on Patient Care

Information sharing by nurses in both ICUs protected patient safety when nurses recognized patient decline, communicated it to other providers and/or enacted corrective strategies. The role of effective communication in patient safety is well established in healthcare (The Joint Commission, 2015). Communication failures can result in delays in treatment,

medication errors, errors in procedures, and many other harmful events (Stewart & Hand, 2017). As a result, healthcare organizations, and ICUs specifically, have worked towards improving and standardizing communication by implementing interdisciplinary rounds (Cavalcanti et al., 2016; Kalyanaraman et al., 2014; Lane et al., 2013; Mullen et al., 2019; Ten Have et al., 2013). These efforts have been reported to improve staff, patient and family perceptions of the ICU as a safe and patient-centered environment, however, there is no evidence yet that implementing rounds decreases patient mortality or ICU length of stay (Cypress, 2012; Kalyanaraman et al., 2014; Lane et al., 2013). This may be because the ongoing information sharing and activities protect patients whether or not ICUs have rounds in place, or it may be because information sharing at rounds is itself imperfect. In one study, researchers found that important information was omitted from rounds discussions with a high frequency. For instance, information on respiratory and blood cultures was omitted at 43% of the rounds interactions observed, and the recommendations for care of non-physician providers was omitted 65% of the time (Artis et al., 2017).

The role of nurses as a "hub" of care coordination is also well established. In other studies, nurses were also identified as "hubs" of communication and care coordination activity (Benton et al., 2015; Creswick et al., 2009). In British Columbia, coordination of care, and collaboration with colleagues has been formally incorporated into the nursing role, and falls within Standard 3: Client-Focused Provision of Service for Registered Nurses and Nurse Practitioners (British Columbia College of Nursing Professionals, 2019).

Nurses also played an important role in ensuring that the wishes of patients and families were enacted. This was most noticeable in end of life care, when nurses communicated with physicians and respiratory therapists about patient and family readiness to remove life sustaining

treatment, and again, this communication took place with urgency, outside of rounds. End of life discussions do occur at rounds for patients who are no longer responding to treatment (personal observation), however, there is often a 'turning point' for patients and family members when they decide to accept end of life care. At this point, the healthcare team responds immediately to the request, rather than requiring patients and families to wait for withdrawal of care, which could be agonizing. The role of ICU nurses in end of life care is an important topic of conversation and study because ICU nurses are confronted with end of life issues frequently, but historically they have not been comfortable with this role (Jang, Park, Kim, & Chang, 2019; Lind, Lorem, Nortvedt, & Hevrøy, 2012).

Q4 - Factors that Enhance and Hinder Information Sharing by Nurses

Studies have shown that strong relationships and trust among colleagues is important for teamwork and collaboration in ICUs, but that this is also difficult to achieve (Laurent, Bonnet, Capellier, Aslanian, & Hebert, 2017; Paradis et al., 2013; Rose, 2011). Rotating schedules and high staff turnover play an important role, and nurses in both ICUs pointed to the loss of trusted colleagues and the influx of new staff as a barrier to communication. Research also shows that tensions can build between staff as they wrestle with emotional issues such transitions from aggressive ICU care to comfort care (Laurent et al., 2017). As well, professional boundaries and perceived hierarchies in healthcare can limit information sharing by nurses (Liberati et al., 2016; Reader, Flin, Mearns, & Cuthbertson, 2007). When nurses cannot, or are reluctant to, share their crucial understanding of patients with other healthcare team members, a significant contribution to DSA is lost.

Handover communication is an important source of information for oncoming nurses, during which gaps in communication can lead to patient safety events. When nurses received

information in sufficient detail, in the format that they expected, and had an opportunity to ask questions, it improved their own ability to provide information to others. Many organizations, including Interior Health, have implemented standardized methods, such as checklists, to support handover communication (Abraham et al., 2014; Clark et al., 2019; Foster-Hunt, Parush, Ellis, Thomas, & Rashotte, 2015; Matic, Davidson, & Salamonson, 2011).

The technology that nurses frequently identified as helpful for communication was Vocera. There is little known about the impact of hands-free communication devices on nursing, except that the technology does appear to be easily accepted and used (Beck & Doscher, 2018). I also observed rare instances of texting between healthcare providers, particularly between charge nurses and physicians or other care providers. While nurses did seek information from the EHR, they did not consider this to be a communication technology, perhaps because nurses do not document in the EHR at either of these sites. Use of the EHR was itself sporadic, possibly because the practice of printing lab and diagnostic imaging reports makes its use optional. This results in so much paper at nursing workstations, however, that there is a risk of nurses relying on incorrect and out of date lab values, a concern that one of the nurses expressed.

Finally, nurses in both ICUs identified interdisciplinary rounds as a support to information sharing. Even though Site A does not have a practice of daily interprofessional rounds, the nurses there are familiar with the concept, and do participate occasionally in 'grand rounds'. Many nurses expressed ambivalence towards rounds, noting that they understood the value of rounds, but that there was a time cost in preparing for rounds and being available to present at rounds. Research has shown that nurses' participation in rounds improves the understanding of patient status and patient care of the entire interprofessional team (Caronia & Saglietti, 2018; Kalyanaraman et al., 2014; Lane et al., 2013; Le Blanc et al., 2010; Mullen et al.,

2019). This contribution is not easy to make, however. Research has shown that nurses with the most impact in rounds are those who have high levels of confidence in their own knowledge, and who are also able to manage conversations, through savvy questioning, requesting second opinions by physicians, and the providing unrequested information (Caronia & Saglietti, 2018; LeBlanc, Lodato, Currow, & Abernethy, 2013). Although the intention of rounds is to provide a platform for all providers to contribute to the patient's plan of care, this does not automatically occur (Artis et al., 2017; Ryan et al., 2019).

In this study, the factors that interfered with information sharing included the lack of a single location to seek and document information, workload, and environmental challenges. In both ICUs nurses expressed frustration with the numerous places that they had to retrieve and document information. One of the sources of confusion is the hybrid chart. In both units, nurses document on paper, while lab, diagnostic imaging, and physician orders can be found both in the EHR and in the paper chart. A previous study has demonstrated that nurses retrieve less information from a hybrid chart than they do from a paper chart, and actually use more non-electronic sources of information in a hybrid environment than in a paper environment (Borycki & Kushniruk, 2015). Unfortunately, implementing a comprehensive EHR does not automatically solve the problem. Studies have shown that after implementation of an EHR, nurses found it more difficult to create an overview of the patient from available information, and more difficult to express their clinical reasoning in the limited spaces that they had for narrative documentation (Schenk et al., 2018; Wisner, Lyndon, & Chesla, 2019).

The hybrid chart is not the only source of confusion for nurses, however. Nurses retrieve information from patients and families, monitoring equipment, and multiple colleagues as well. The enormous amount of information that is available throughout the unit at different times and

in different places, creates a large cognitive load and may impede nurses' ability to synthesize information (Jeffery, Kennedy, Dietrich, Mion, & Novak, 2017). At best, this can be tiring for nurses, and at worst it can lead to errors. One solution is to improve the design of monitor displays, by integrating more information into one display, as Koch et al. found (Koch et al., 2013).

Nurses in both units identified workload as a barrier to information sharing. Previous studies have demonstrated the impact of heavy workloads on documentation quality, noting that heavy workloads can contribute to incomplete documentation (Maputle, Lebesse, & Shihundla, 2016). Nurses have also expressed concerns that heavy workloads interferes with their ability to communicate with, and provide adequate information to, patients and families (Conroy, 2018; Hemsley, Balandin, & Worrall, 2012).

Nurses in both units also identified the unit layout as an impediment to information sharing. Both units were newly built in 2011 with workstations distributed near patient rooms. Nurses admitted that the new ICUs were spacious, but the layout impeded teamwork. Nurses reminisced about their previous ICUs which were cramped, but staff 'just knew' when a colleague was overwhelmed, or when a patient was struggling, and they would help each other without being asked. Today's modern healthcare settings are designed to improve efficiency, decrease interruptions, and increase patient safety through proximity of nurses to their patients (Hua, Becker, Wurmser, Bliss-Holtz, & Hedges, 2012; Lu, Ossmann, Leaf, & Factor, 2014; Zadeh, Shepley, & Waggener, 2012). There is conflicting research as to whether these unit design changes benefit patients and staff, however. In one pre-post design study there was no change in nursing communication patterns, distance walked, satisfaction, or patient safety and satisfaction (Zadeh et al., 2012). In another study, modern decentralized multi-hub unit was

associated with improved communication between nurses and decreased patient fall rates (Hua et al., 2012). There does seem to be a trade-off for nurses in the study ICUs who appreciated the proximity of their workstations to their patients, but found the long linear structure of the ICUs to be isolating.

ICU Nurses, ICU Rounds and Distributed Situation Awareness Theory

The nursing contribution to DSA through information sharing was highly visible during this study. Nurses' distinctive contributions to the DSA of the ICU team occurred through sharing of their unique information. Interdisciplinary rounds undoubtedly provided a platform for nurses to share their unique information with the team, however, nurses would not wait for rounds if they needed to share something time-sensitive, or if waiting would cause patient physical or psychological harm. In sum, rounds was an identified facilitator of nurse information sharing, and therefore DSA, but it appeared no more important to nurses than technology, or workload or other factors that they identified.

Many of the qualities of information sharing identified in this study were previously identified by others, and incorporated into the model original model of DSA (Salmon, et al. 2017; Stanton, 2016; Stanton et al., 2017; Stanton et al., 2006). For example, with respect to Question 1, the unique information shared by nurses is heavily influenced by individual SA requirements of the nursing role and the knowledge and experience of nurses themselves. This is seen in *Individual Factors* on the original model of DSA (Figure 5.1).

In Question 2 of this study, further characteristics of information sharing, such as how, where, and with whom information was shared were explored, and many of these were identified in the original DSA model as well. For example, the different members of the interdisciplinary team with whom nurses share information maps to *Team Factors* in the original model (Figure

5.1). Likewise, the ways in which information was gathered and shared, through organized interdisciplinary rounds, and technological systems, can be viewed as fitting within *System Factors* in the original model. I believe, however, that the use of the umbrella term *System Factors*, is unclear and that there are several systems at work. As well, the placement of *System Factors* to the right side of the image belies the fact that the individuals, teams, and tasks are actually embedded within the system, and therefore influenced by it.

I have created a modest extension to the model (Figure 5.2), in which *System Factors* are teased apart to include: a) the *Organization System*, which includes organizational and unit policies, and staffing models; b) the *Physical System*, which includes the physical layout of the ICU; and c) the *Technical System*, which includes the technical environment, such as a hybrid EHR environment, the interoperability (or lack thereof) of technology, and the presence of cardiac monitors, ventilators. The *Technical System* refers to the overall technical environment, and not the specific qualities of the devices themselves, which are considered *Device Factors*. These larger systems are placed in a larger box surrounding *Individual, Team, Task* and *Device Factors* to denote that they provide the environment in which those factors are embedded.

The results of Question 3 of this study, the impact of information sharing by nurses on patient care, can be visualized in a subtle way in the original model, in that the SA transactions between agents and artefacts are shown as double-sided arrows, indicating that they influence one another. In the extended model, I have kept these interactions between agents and artefacts, and added double-sided arrows between the DSA box and *Individual, Team, Task* and *Device Factors*. These arrows indicate that the interaction of individuals, teams and devices not only creates DSA, but that the resulting DSA in turn influences and changes the individuals, teams

and devices. For instance, the arising DSA may impact the knowledge of an individual nurse, or the communication within a team.

The results of Question 4, factors that improve and impede information sharing, can also be mapped to both the original and extended DSA models. In the original model (Figure 5.1), the factors that improve information sharing are visualized under *Team Factors* (relationships, handover communication), and *System Factors* (interdisciplinary rounds, technology). In the extended model (Figure 5.2), interdisciplinary rounds falls under *Organization Factors*, and technological devices falls within the *Technical System* and *Device Factors*.

Finally, with respect to factors that impede information sharing, workload can be visualized under *Task Factors* in both the original and extended models. Likewise, 'colleagues who do not listen' falls within *Team Factors* of both models. However, the factors of noise, physical layout, and lack of a single place for information map to *System Factors* in the original model, and to *Physical System* and *Organization System* in the extended model.

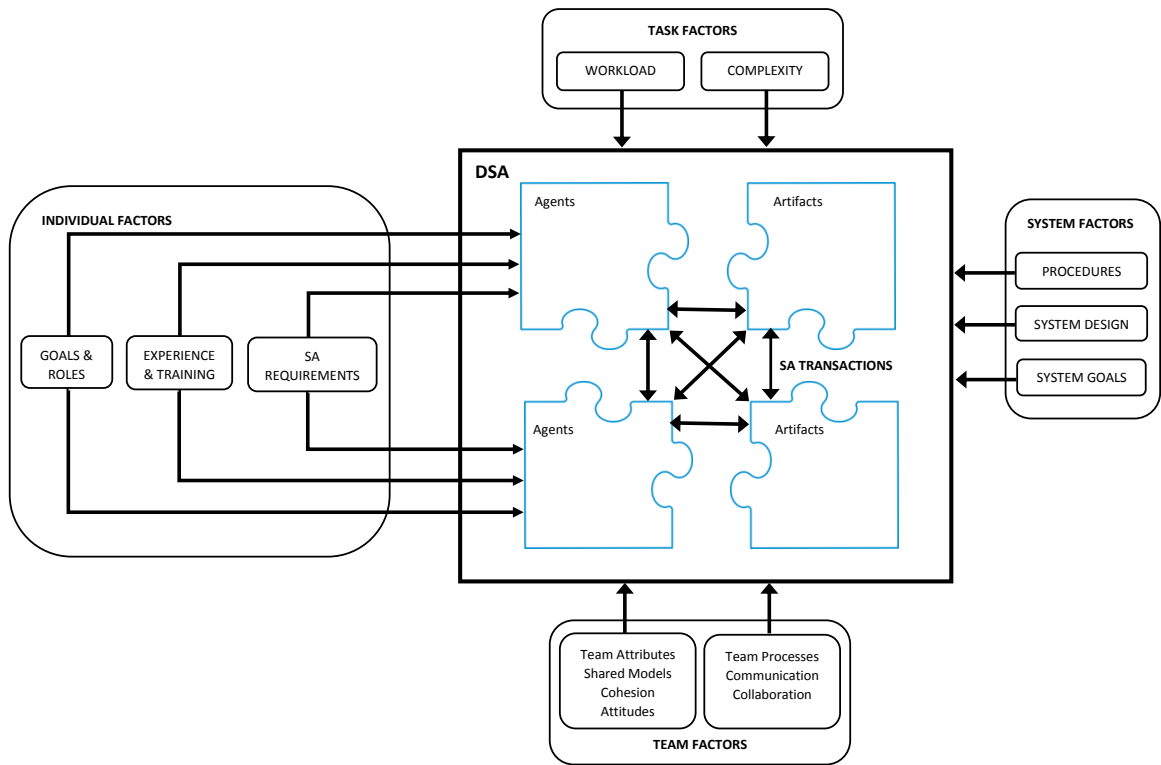


Figure 5.1: The original model of Distributed Situation Awareness (Salmon et al., 2017, p. 200).

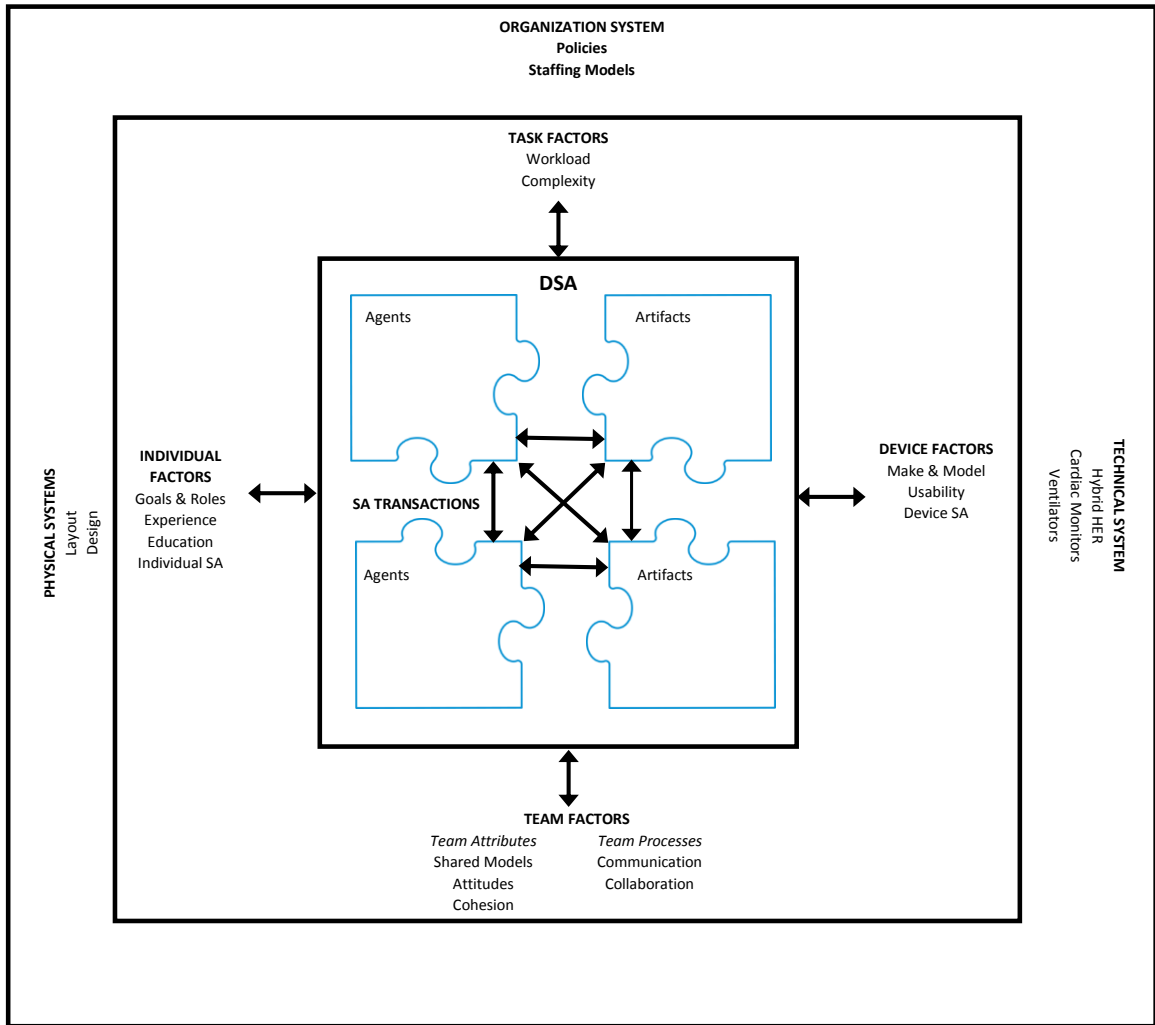


Figure 5.2: A model of DSA. Revised and extended from Salmon et al. (2017, p. 200). Key changes from the original model include: a) separating *System Factors* into *Physical Systems*, *Organization Systems*, and *Technical Systems*; b) placing the *Physical*, *Organization* and *Technical Systems* in a large box surrounding *Individual*, *Team*, *Device*, and *Task Factors* to indicate that that the Systems denote the environment; c) including *Device Factors*, to compliment and mirror *Individual* and *Team Factors*, and d) adding double arrows between *Individual*, *Team*, *Device*, and *Task Factors* to indicate that these factors and DSA influence each other.

Limitations of the Study

This is a small, comparative observational study, and as such, it offers insights and opportunities for future research, but does not provide generalizable conclusions. One limitation is the selection bias that arises from the study participants. For example, the sample size was very small. It included 32 hours of observations and conversations with four nurses per ICU and an additional chart review follow-up. In addition, the study participants were recruited by colleagues of mine, and as such, were friends of friends, which represents clear selection bias. Finally, nursing practice experience was a potential confounder. The study nurse with the least amount of experience had 5 years of experience in critical care areas, and the other nurses had more than 10 years. They had obvious above-average technical and communication skills, which may have made them open to being observed. The communication patterns of these expert nurses may not reflect that patterns of nurses who were new to critical care. For example, a newer nurse may make more calls to the physician, or might consult nurse colleagues more often.

The comparison between the ICUs also has limitations. While the ICUs were similar in structure, the acuity in the ICUs, particularly on the study days, was quite different, with Site B experiencing much higher acuity than Site A. As well, all Site A study nurses cared for one patient at a time, while all but one nurse at Site B cared for two. These differences alone could have led to different information sharing patterns by the nurses, though, interestingly, there were numerous similarities in information sharing patterns among the nurses.

The study was conducted using the rapid qualitative inquiry method of investigation. As Beebe (2015) warns, rapid qualitative inquiry provides a large amount of preliminary data, and a general overview of a phenomenon, but it cannot provide the same depth of insight as prolonged ethnographic fieldwork can. This study, therefore, provides an overview of information sharing

in these two ICUs by a small selection of expert nurses, and provides some understanding of the impact that interdisciplinary rounds has on information sharing by nurses.

Contributions and Recommendations for Research and Practice

In spite of its limitations, this study makes several contributions towards furthering our understanding of information sharing patterns by ICU nurses, ICU nurse contributions to DSA, and the factors that influence information sharing in ICU settings. I am unaware of any study that has examined information sharing by ICU nurses with patients, families and different care providers by time, space and modality. There are numerous studies examining communication with physicians, or communication with patients and families, and studies that examine nurse contributions to rounds, or nurse interactions with the interdisciplinary team (Adams et al., 2017; Artis et al., 2017; Kalyanaraman et al., 2014; Knoll & Lendner, 2008; Rose, 2011; Ryan et al., 2019; Shoham et al., 2016). This study builds on these studies by exploring the content of these interactions and how these interactions occur in the physical environment.

I recommend that researchers conduct further studies of information sharing in ICU settings using rapid qualitative inquiry. These studies should, however, involve a team of researchers who can conduct observations on patients, critical care nurses, physicians, patient care coordinators, and allied health members simultaneously. This information will help scientists understand information sharing patterns from multiple perspectives, and help inform ICU design that best meets the care and communication needs of ICU stakeholders. The rapid nature and minimal impact to operations of this type of study makes it feasible to conduct.

This study contributes to the growing body of evidence that helps us to understand nursing ambivalence toward interdisciplinary rounds (Artis et al., 2017; Kalyanaraman et al., 2014; Ryan et al., 2019). The study demonstrates the different relationship that nurses have to

interdisciplinary rounds than their physician and allied health colleagues do. For many of their non-nursing colleagues, interdisciplinary rounds may represent the most important communication opportunity for them about a given patient in an entire shift. For nurses in ICU, who closely monitor one to two patients throughout the shift, rounds represented an opportunity to share routine findings, but many of the most important opportunities for sharing information are non-routine, occur outside of rounds, and require them reach out and contact another provider.

I recommend further research in ICU settings on rounds, and nursing contributions in rounds, using interviews and observations. Such studies would build on this study, and that of previous research, to help us understand nursing's role in rounds, and whether unique, but routine, contributions indeed influence patient care. This research may help clinicians structure rounds in such a way that nursing contributions move beyond an information sharing role toward contributing to patient care recommendations.

This study highlighted the enormous volume of information that ICU nurses must synthesize in order to perform patient care, and contribute to the DSA of the ICU. Organizing documentation and information sources is an issue that requires dedication and effort on the part of organizational leadership, nurse managers, educators and nurses themselves. First, organizations must eliminate the hybrid chart. This is expensive, but it will reduce the cognitive load and frustration associated with having so many different information sources, and locations for documentation. Second, organizations should develop a coherent documentation framework and strategy for nurses, to minimize the non-stop introduction of new, overlapping documentation tools, reduce the burden of documentation, and improve the quality of documentation.

This study also contributes to our understanding of nursing's contributions to DSA in the ICU setting. By exploring information sharing in time and space, and the factors that support and impede it, this study provides nursing and ICU examples to support and extend DSA theory. An interesting area for future research could be to more deeply explore each facet of the DSA model in the ICU setting. For instance, while this study provided some examples in each of the model's domains, future studies could explore system factors, such as policy and procedures and their influence on DSA, while another study could explore the influence of the technological system of the ICU on DSA.

Conclusions

There are two important outcomes from this study. The first is that interdisciplinary rounds had a minimal impact on nurse information sharing. Information sharing patterns by nurses in the two ICUs were similar in terms of information sources, location of information sharing, and factors that facilitate and impede information sharing. There were, however, some differences in the type and frequency of the practitioners with whom the nurses interacted. At Site A, nurses contacted physicians twice as often as the Site B nurses did, in spite of lower patient acuity and caring for fewer patients, which may be the result of the consistent rounding practice at Site B.

The second important outcome of the study is that it highlighted the ways in which detailed knowledge of information sharing in different environments allows us to test and revise existing models of information sharing and DSA. Many of the results from this study supported the model of DSA presented by Stanton and others. The results presented here also matched the model better when it was revised to highlight the importance of the environment, and to allow for visualization of the way in which of DSA impacts outcomes.

References

- Abbott, S., Rogers, M., & Freeth, D. (2012). Underpinning safety: communication habits and situation awareness. *British Journal of Midwifery*, 20(4), 279-284.
doi:10.12968/bjom.2012.20.4.279
- Abraham, J., Kannampallil, T., & Patel, V. L. (2014). A systematic review of the literature on the evaluation of handoff tools: implications for research and practice. *Journal of the American Medical Informatics Association*, 21(1), 154-162. doi:10.1136/amiajnl-2012-001351
- Ackerman, S., Gleason, N., & Gonzales, R. (2015). Using rapid ethnography to support the design and implementation of health information technologies. In L. Botin, P. Bertlesen, & C. Nohr (Eds.), *Techno-anthropology in health informatics: methodologies for improving human-technology relations* (pp. 14-27). Washington, DC.: IOS Press.
- Adams, A. M. N., Mannix, T., & Harrington, A. (2017). Nurses' communication with families in the intensive care unit - a literature review. *Nursing in Critical Care*, 22(2), 70-80.
doi:10.1111/nicc.12141
- Adams, J. A., Bailey, J. D. E., Anderson, R. A., & Docherty, S. L. (2011). Nursing roles and strategies in end-of-life decision making in acute care: a systematic review of the literature. *Nursing Research and Practice*, 2011, 1-15, doi:10.1155/2011/527834
- Alvarez, G., & Coiera, E. (2006). Interdisciplinary communication: An uncharted source of medical error? *Journal of Critical Care*, 21(3), 236-242.
- Artis, K. A., Bordley, J., McGrath, K., Mohan, V., & Gold, J. A. (2017). What I'm not telling you - a comprehensive description of data omitted during daily ICU rounds. *American Journal of Respiratory and Critical Care Medicine*, 195.

- Artis, K. A., Dyer, E., Mohan, V., & Gold, J. A. (2017). Accuracy of laboratory data communication on ICU daily rounds using an electronic health record. *Critical Care Medicine, 45*(2), 179-186. doi:10.1097/CCM.0000000000002060
- Ash, J. S., Sittig, D. F., McMullen, C. K., Guappone, K., Dykstra, R., & Carpenter, J. (2008). *A rapid assessment process for clinical informatics interventions*. American Medical Informatics Association Symposium Proceedings, Washington, DC.
- Ash, J. S., Sittig, D. F., McMullen, C. K., Wright, A., Bunce, A., Mohan, V., . . . Middleton, B. (2015). Multiple perspectives on clinical decision support: a qualitative study of fifteen clinical and vendor organizations. *Biomed Central Medical Informatics and Decision Making, 15*, 35.
- Baggs, J.G., & Schmitt, M.H. (1997). Nurses' and resident physician's perceptions of the process of collaboration in a MICU. *Research in Nursing and Health, (1)* 71-80.
- Bagshaw, S. M., Opgenorth, D., Potestio, M., Hastings, S. E., Hepp, S. L., Gilfoyle, E., . . . Stelfox, H. T. (2017). Healthcare provider perceptions of causes and consequences of ICU capacity strain in a large publicly funded integrated health region: a qualitative study. *Critical Care Medicine, 45*(4), e347-e356. doi:10.1097/CCM.0000000000002093
- Barosso, J., & Cameron, C. (2013). Qualitative approaches to research. In G. LoBiondo-Wood, J. Haber, C. Cameron, & G. K. Singh (Eds.), *Nursing Research in Canada* (3rd ed., pp. 167-194). Toronto, ON: Elsevier, Canada.
- Beck, M. S., & Doscher, M. (2018). Effects of patient care unit design and technology on nurse and patient care technician communication. *Journal of Gerontological Nursing, 44*(4), 17-22. doi:10.3928/00989134-20180212-01

- Beebe, J. (2014). *Rapid qualitative inquiry: a field guide to team-based assessment* (2nd ed.). London, UK: Rowman & Littlefield.
- Benton, D. C., Pérez-Raya, F., Fernández-Fernández, M. P., & González-Jurado, M. A. (2015). A systematic review of nurse-related social network analysis studies: social network analysis: a systematic review. *International Nursing Review*, 62(3), 321-339.
doi:10.1111/inr.12161
- Bleakley, A., Allard, J., & Hobbs, A. (2013). 'Achieving ensemble': communication in orthopaedic surgical teams and the development of situation awareness--an observational study using live videotaped examples. *Advances in Health Sciences Education*, 18(1), 33-56.
- Borycki, E., & Kushniruk, A. (2015). Use of techno-anthropologic approaches in studying technology-induced errors. In L. Botin, P. Bertelsen, & C. Nohr (Eds.), *Techno-anthropology in health informatics: methodologies for improving human-technology relations* (pp. 129-144). Washington, DC: IOS Press.
- Borycki, E. M. Evaluating the impact of hybrid electronic-paper environments upon novice nurse information seeking. *Methods of Information in Medicine*, 48(2).
- British Columbia College of Nursing Professionals. (2018). *Communication within the standards of nursing practice*. British Columbia.
- British Columbia College of Nursing Professionals. (2019). *Standard 3: client-focused provision of service*.
- Canadian Patient Safety Institute. (2011). *Canadian framework for teamwork and communication: literature review, needs assessment, evaluation of training tools and expert consultations*. Edmonton (AB): Canadian Patient Safety Institute

- Caronia, L., & Saglietti, M. (2018). Knowledge and agency in interprofessional care: how nurses contribute to the case-construction in an intensive care unit. *Journal of Interprofessional Care, 32*(5), 592-602. doi:10.1080/13561820.2018.1463199
- Cavalcanti, A. B., Bozza, F. A., Machado, F. R., Salluh, J. I. F., Campagnucci, V. P., Vendramim, P., . . . Berwanger, O. (2016). Effect of a quality improvement intervention with daily round checklists, goal setting, and clinician prompting on mortality of critically ill patients: a randomized clinical trial. *Journal of the American Medical Association, 315*(14), 1480-1490. doi:10.1001/jama.2016.3463
- Clark, J. R., Stanton, N. A., & Revell, K. M. A. (2019). Identified handover tools and techniques in high-risk domains: using distributed situation awareness theory to inform current practices. *Safety Science, 118*, 915-924. doi:10.1016/j.ssci.2019.06.033
- Clarke, D., Duke, J., Wuliji, T., Smith, A., Phuong, K., Un, S., & San, U. (2016). Strengthening health professions regulation in Cambodia: a rapid assessment. *Human Resources for Health, 14*, 1-9. doi:10.1186/s12960-016-0104-0
- Collins, S.A., & Currie, L.M. (2009). Interdisciplinary communication in the ICU. *Studies in Health Technology and Informatics (146)*, 362-366.
- Conroy, T. (2018). Factors influencing the delivery of the fundamentals of care: perceptions of nurses, nursing leaders and healthcare consumers. *Journal of Clinical Nursing, 27*(11-12), 2373-2386. doi:10.1111/jocn.14183
- Coolen, E., Draaisma, J., & Loeffen, J. (2019). Measuring situation awareness and team effectiveness in pediatric acute care by using the situation global assessment technique. *European Journal of Pediatrics, 178*(6), 837-850. doi:10.1007/s00431-019-03358-z

- Cooper, S., Kinsman, L., Buykx, P., McConnell-Henry, T., Endacott, R., & Scholes, J. (2010). Managing the deteriorating patient in a simulated environment: nursing students' knowledge, skill and situation awareness. *Journal of Clinical Nursing, 19*(15-16), 2309-2318. doi:10.1111/j.1365-2702.2009.03164.x
- Cornell, P., Townsend-Gervis, M., Vardaman, J. M., & Yates, L. (2014). Improving situation awareness and patient outcomes through interdisciplinary rounding and structured communication. *Journal of Nursing Administration, 44*(3), 164-169. doi:10.1097/NNA.0000000000000045
- Creswick, N., Westbrook, J. I., & Braithwaite, J. (2009). Understanding communication networks in the emergency department. *BMC Health Services Research, 9*(1), 247-247. doi:10.1186/1472-6963-9-247
- Crozier, M. S. M. D., Ting, H. Y. M. D., Boone, D. C. M. D., O'Regan, N. B. M. D., Bandrauk, N. M. D., Furey, A. M. D., . . . Hogan, M. P. M. D. (2014). Use of human patient simulation and validation of the Team Situation Awareness Global Assessment Technique (TSAGAT): a multidisciplinary team assessment tool in trauma education. *Journal of Surgical Education, 72*(1), 156-163. doi:10.1016/j.jsurg.2014.07.009
- Cypress, B. S. (2012). Family presence on rounds: a systematic review of literature. *Dimensions of Critical Care Nursing, 31*(1), 53-64. doi:10.1097/DCC.0b013e31824246dd
- Dayton, E., & Henriksen, K. (2007). Communication failure: basic components, contributing factors, and the call for structure. *The Joint Commission Journal on Quality and Patient Safety, 33*(1), 34-47.
- Drews, F. A., & Doig, A. (2014). Evaluation of a configural vital signs display for intensive care unit nurses. *Human Factors, 56*(3), 569-580.

- Endsley, M. R. (1995). Toward a theory of situation awareness in dynamic systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 37(1), 32-64.
doi:10.1518/001872095779049543
- Endsley, M. R. (2015). Final reflections: situation awareness models and measures. *Journal of Cognitive Engineering and Decision Making*, 9(1), 101-111.
doi:10.1177/1555343415573911
- Fioratou, E., Chatzimichailidou, M. M., Grant, S., Glavin, R., Flin, R., & Trotter, C. (2016). Beyond monitors: distributed situation awareness in anaesthesia management. *Theoretical Issues in Ergonomics Science*, 17(1), 104-124.
doi:10.1080/1463922X.2015.1106620
- Foster-Hunt, T., Parush, A., Ellis, J., Thomas, M., & Rashotte, J. (2015). Information structure and organisation in change of shift reports: an observational study of nursing hand-offs in a paediatric intensive care unit. *Intensive & Critical Care Nursing*, 31(3), 155-164.
doi:10.1016/j.iccn.2014.09.004
- Frank, J. R., & Brien, S. (2009). *The safety competencies: enhancing patient safety across the health professions*. Ottawa, ON: Canadian Patient Safety Institute
- Gluyas, H., & Harris, S.J. (2016). Understanding situation awareness and its importance in patient safety. *Nursing Standard*, 30(34), 50-60.
- Goldenhar, L. M., Brady, P. W., Sutcliffe, K. M., & Muething, S. E. (2013). Huddling for high reliability and situation awareness. *BMJ Quality & Safety*, 22(11), 899-906.
doi:10.1136/bmjqs-2012-001467

- Green, B., Parry, D., Oeppen, R. S., Plint, S., Dale, T., & Brennan, P. A. (2017). Situational awareness – what it means for clinicians, its recognition and importance in patient safety. *Oral Diseases*, 23(6), 721-725. doi:10.1111/odi.12547
- Gundrosen, S., Solligård, E., & Aadahl, P. (2014). Team competence among nurses in an intensive care unit: the feasibility of in situ simulation and assessing non-technical skills. *Intensive & Critical Care Nursing*, 30(6), 312-317. doi:10.1016/j.iccn.2014.06.007
- Gurses, A. P., & Xiao, Y. (2006). A systematic review of the literature on multidisciplinary rounds to design information technology. *Journal of the American Medical Informatics Association*, 13(3), 267-276. doi:10.1197/jamia.M1992
- Haber, J. A., Ellaway, R. H., Chun, R., & Lockyer, J. M. (2017). Exploring anesthesiologists' understanding of situational awareness: a qualitative study. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*, 64(8), 810-819. doi:10.1007/s12630-017-0904-2
- Hemsley, B., Balandin, S., & Worrall, L. (2012). Nursing the patient with complex communication needs: time as a barrier and a facilitator to successful communication in hospital. *Journal of Advanced Nursing*, 68(1), 116-126. doi:10.1111/j.1365-2648.2011.05722.x
- Hsieh, H.-F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-1288. doi:10.1177/1049732305276687
- Hua, Y., Becker, F., Wurmser, T., Bliss-Holtz, J., & Hedges, C. (2012). Effects of nursing unit spatial layout on nursing team communication patterns, quality of care, and patient safety. *Health Environments Research & Design Journal*, 6(1), 8-38. doi:10.1177/193758671200600102

- Jang, S. K., Park, W. H., Kim, H.-I., & Chang, S. O. (2019). Exploring nurses' end-of-life care for dying patients in the ICU using focus group interviews. *Intensive and Critical Care Nursing, 52*, 3-8. doi:<https://doi.org/10.1016/j.iccn.2018.09.007>
- Jeffery, A. D., Kennedy, B., Dietrich, M. S., Mion, L. C., & Novak, L. L. (2017). A qualitative exploration of nurses' information-gathering behaviors prior to decision support tool design. *Applied Clinical Informatics, 8*(3), 763-778. doi:10.4338/ACI-2017-02-RA-0033
- Joint Commission. (2015). Sentinel event data: root causes by event type.
- Jones, C. P. L., Fawker-Corbett, J., Groom, P., Morton, B., Lister, C., & Mercer, S. J. (2018). Human factors in preventing complications in anaesthesia: a systematic review. *Anaesthesia Supplement, 73*, 12-24. doi:10.1111/anae.14136
- Jones, D. G. (2015). A practical perspective on the utility of situation awareness. *Journal of Cognitive Engineering and Decision Making, 9*(1), 98-100.
doi:10.1177/1555343414554804
- Kalyanaraman, M., McQueen, D., Sykes, J. A., Mikkilineni, S., Aizley, C., Kelly, M. J., & Wiggins, M. (2014). Impact of nurse integrated rounds on self-reported comprehension, attitudes, and practices of nurses and resident physicians in a pediatric intensive care unit. *Journal of Intensive Care Medicine, 29*(5), 285-291. doi:10.1177/0885066613486612
- Kang, E., Massey, D., & Gillespie, B. M. (2015). Factors that influence the non- technical skills performance of scrub nurses: a prospective study. *Journal of Advanced Nursing, 71*(12), 2846-2857. doi:10.1111/jan.12743
- Keen, D., & De Chesnay, M. (2014). State of the art in nursing research using ethnography. In M. De Chesnay (Ed.), *Nursing research using ethnography: qualitative designs and methods in nursing* (pp. 15-36). New York: Springer Publishing Company.

- Kelly, F. E., Fong, K., Hirsch, N., & Nolan, J. P. (2014). Intensive care medicine is 60 years old: the history and future of the intensive care unit. *Clinical Medicine*, *14*(4), 376-379. doi:10.7861/clinmedicine.14-4-376.
- Knoll, M., & Lendner, I. (2008). Nurses' perspective on interprofessional communication on an intensive care unit. *Pflege*, *21*(5), 339-351.
- Koch, S. H., Weir, C., Westenskow, D., Gondan, M., Agutter, J., Haar, M., . . . Staggers, N. (2013). Evaluation of the effect of information integration in displays for ICU nurses on situation awareness and task completion time: A prospective randomized controlled study. *International Journal of Medical Informatics*, *82*(8), 665-675. doi:<https://doi.org/10.1016/j.ijmedinf.2012.10.002>
- Kohn, L. T., Corrigan, J. M., & Donaldson, M. S. (2000). *To err Is human: building a safer health system*. Washington, DC.: National Academies Press.
- Korkiakangas, T., Weldon, S.M., Bezemer, J., & Kneebone, R. (2014). Nurse–surgeon object transfer: video analysis of communication and situation awareness in the operating theatre. *International Journal of Nursing Studies*, *51*(9), 1195-1206. doi:10.1016/j.ijnurstu.2014.01.007
- Lane, D., Ferri, M., Lemaire, J., McLaughlin, K., & Stelfox, H. T. (2013). A systematic review of evidence-informed practices for patient care rounds in the ICU. *Critical Care Medicine*, *41*(8), 2015-2029. doi:10.1097/CCM.0b013e31828a435f
- Laurent, A., Bonnet, M., Capellier, G., Aslanian, P., & Hebert, P. (2017). Emotional impact of end-of-life decisions on professional relationships in the ICU: an obstacle to collegiality? *Critical Care Medicine*, *45*(12), 2023-2030. doi:10.1097/CCM.0000000000002710

- Lauria, M. J., Ghobrial, M. K., & Hicks, C. M. (2019). Force of habit: developing situation awareness in critical care transport. *Air Medical Journal*, 38(1), 45-50.
doi:10.1016/j.amj.2018.09.007
- Lavoie, P., Cossette, S., & Pepin, J. (2016). Testing nursing students' clinical judgment in a patient deterioration simulation scenario: development of a situation awareness instrument. *Nurse Education Today*, 38, 61-67. doi:10.1016/j.nedt.2015.12.015
- Lawton, R., McEachan, R. R. C., Giles, S. J., Sirriyeh, R., Watt, I. S., & Wright, J. (2012). Development of an evidence-based framework of factors contributing to patient safety incidents in hospital settings: a systematic review. *BMJ Quality & Safety*, 21(5), 369-380.
doi:10.1136/bmjqs-2011-000443
- Le Blanc, P. M., Schaufeli, W. B., Salanova, M., Llorens, S., & Nap, R. E. (2010). Efficacy beliefs predict collaborative practice among intensive care unit nurses. *Journal of Advanced Nursing*, 66(3), 583-594. doi:10.1111/j.1365-2648.2009.05229.x
- LeBlanc, T. W., Lodato, J. E., Currow, D. C., & Abernethy, A. P. (2013). Overcoming recruitment challenges in palliative care clinical trials. *J Oncol Pract*, 9(6), 277-282.
doi:10.1200/jop.2013.000996
- Leininger, M. (1997). Overview of the theory of culture care with the Ethnonursing Research Method. *Journal of Transcultural Nursing*, 8(2), 32-52.
doi:10.1177/104365969700800205
- Liberati, E. G., Gorli, M., & Scaratti, G. (2016). Invisible walls within multidisciplinary teams: disciplinary boundaries and their effects on integrated care. *Social Science & Medicine*, 150, 31-39. doi:<https://doi.org/10.1016/j.socscimed.2015.12.002>

- Lin, F., Chaboyer, W., & Wallis, M. (2014). Understanding the distributed cognitive processes of intensive care patient discharge. *Journal of Clinical Nursing, 23*(5-6), 673-682.
doi:10.1111/jocn.12194
- Lind, R., Lorem, G. F., Nortvedt, P., & Hevrøy, O. (2012). Intensive care nurses' involvement in the end-of-life process – perspectives of relatives. *Nursing Ethics, 19*(5), 666-676.
doi:10.1177/0969733011433925
- Lo, L. (2011). *Teamwork and communication in healthcare: a literature review*. Canadian Patient Safety Institute.
- LoBiondo-Wood, G., Haber, J., & Singh, M. D. (2013). Nonexperimental designs. In G. LoBiondo-Wood, J. Haber, C. Cameron, & M. D. Singh (Eds.), *Nursing research in Canada: methods, critical appraisal, and utilization* (Third ed., pp. 235-252). Toronto, ON: Elsevier Canada.
- Lu, Y., Ossmann, M. M., Leaf, D. E., & Factor, P. H. (2014). Patient visibility and ICU mortality: a conceptual replication. *Health Environments Research & Design Journal, 7*(2), 92-103. doi:10.1177/193758671400700206
- Luo, S., & Yang, H. H. (2018). Using technologies in nursing research education: a mixed methods case study. *CIN: Computers, Informatics, Nursing, 36*(6), 293-304.
doi:10.1097/CIN.0000000000000420
- Maputle, M. S., Lebesse, R. T., & Shihundla, R. C. (2016). Effects of increased nurses' workload on quality documentation of patient information at selected Primary Health Care facilities in Vhembe District, Limpopo Province : original research. *Curationis, 39*(1), 1-8.

- Matic, J., Davidson, P. M., & Salamonsen, Y. (2011). Review: bringing patient safety to the forefront through structured computerisation during clinical handover. *Journal of Clinical Nursing, 20*(1-2), 184-189. doi:10.1111/j.1365-2702.2010.03242.x
- McFarland, M. R., Mixer, S. J., Webhe-Alamah, H., & Burk, R. (2012). Ethnonursing: a qualitative research method for studying culturally competent care across disciplines. *International Journal of Qualitative Methods, 11*(3), 259-279. doi:10.1177/160940691201100306
- McMullen, C. K., Ash, J. S., Sittig, D. F., Bunce, A., Guappone, K., Dykstra, R., . . . Wright, A. (2011). Rapid assessment of clinical information systems in the healthcare setting: an efficient method for time-pressed evaluation. *Methods of Information in Medicine, 50*(4), 299-307. doi:10.3414/ME10-01-0042
- Mullen, J., Reynolds, M., Marante, A., & Avery, L. (2019). Nurse-integrated rounds improve communication in the pediatric intensive care unit. *Critical Care Medicine, 47*, 688-688. doi:10.1097/01.ccm.0000552167.89237.b5
- Ng'ang'a, N., Woods Byrne, M., & Anh Ngo, T. (2014). In their own words: the experience of professional nurses in a Northern Vietnamese women's hospital. *Contemporary Nurse, 47*(1-2), 168-179. doi:10.1080/10376178.2014.11081918
- O'Meara, P., Munro, G., Williams, B., Cooper, S., Bogossian, F., Ross, L., . . . McClounan, M. (2015). Developing situation awareness amongst nursing and paramedicine students utilizing eye tracking technology and video debriefing techniques: a proof of concept paper. *International Emergency Nursing, 23*(2), 94-99. doi:10.1016/j.ienj.2014.11.001
- Oriq, S. B., & Despina, L. (2018). Evaluating situation awareness: an integrative review. *Western Journal of Nursing Research, 40*(3).

- Paiva, L., Rossi, L. A., Silva, M.C. C., & Spadoti, R.A.D. (2010). The experiences and consequences of a multiple trauma event from the perspective of the patient. *Revista Latino-Americana de Enfermagem*, 18(6), 1221-1228. doi:10.1590/S0104-11692010000600024
- Paradis, E., Leslie, M., Gropper, M. A., Aboumatar, H. J., Kitto, S., & Reeves, S. (2013). Interprofessional care in intensive care settings and the factors that impact it: results from a scoping review of ethnographic studies. *Journal of Critical Care*, 28(6), 1062-1067. doi:10.1016/j.jcrc.2013.05.015
- Pascale, M. T., Sanderson, P., Liu, D., Mohamed, I., Brecknell, B., & Loeb, R. G. (2019). The impact of head-worn displays on strategic alarm management and situation awareness. *Human Factors*, 61(4), 537-563. doi:10.1177/0018720818814969
- Patterson, C., Procter, N., & Toffoli, L. (2016). Situation awareness: when nurses decide to admit or not admit a person with mental illness as an involuntary patient. *Journal of Advanced Nursing*, 72(9), 2042-2053. doi:10.1111/jan.13024
- Patterson, C., Procter, N., & Toffoli, L. (2017). When I say ... situation awareness. *Medical Education*, 51(7), 683-684. doi:10.1111/medu.13226
- Patton, M. Q. (2008). *Utilization-focused evaluation* (Vol. 4). Thousand Oaks: Sage Publications.
- Patton, M. Q. (2015). *Qualitative research and evaluation methods: integrating theory and practice* (4th ed.). Thousand Oaks, California: SAGE Publications, Inc.
- Peters, J. S. (2017). Role of transitional care measures in the prevention of readmission after critical illness. *Critical Care Nurse*, 37(1), e10-e17. doi:10.4037/ccn2017218

- Reader, T. W., Flin, R., Mearns, K., & Cuthbertson, B. H. (2007). Interdisciplinary communication in the intensive care unit. *The British Journal of Anaesthesia*, 98(3), 347-352. doi:bj/a/ael372
- Reader, T. W., Flin, R., Mearns, K., & Cuthbertson, B. H. (2011). Team situation awareness and the anticipation of patient progress during ICU rounds. *BMJ Quality & Safety*, 20(12), 1035-1042. Retrieved from <http://ezproxy.library.uvic.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=ccm&AN=104619622&login.asp&site=ehost-live&scope=site>
- Reay, G., Rankin, J. A., & Then, K. L. (2016). Momentary fitting in a fluid environment: A grounded theory of triage nurse decision making. *International Emergency Nursing*, 26, 8-13. doi:<https://doi.org/10.1016/j.ienj.2015.09.006>
- RiskAnalytica. (2017). *The case for investing in patient safety in Canada*.
- Rose, L. (2011). Interprofessional collaboration in the ICU: how to define? *Nursing in Critical Care*, 16(1), 5-10. doi:10.1111/j.1478-5153.2010.00398.x
- Ryan, L., Jackson, D., Woods, C., & Usher, K. (2019). Intentional rounding – An integrative literature review. *Journal of Advanced Nursing*, 75(6), 1151-1161. doi:10.1111/jan.13897
- Salas, E., Prince, C., Baker, D. P., & Shrestha, L. (1995). Situation awareness in team performance: implications for measurement and training. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 37(1), 123-136. doi:10.1518/001872095779049525
- Salmon, Paul M., Stanton, N.A., Walker, G.H., & Jenkins, D.P.(2017). Distributed situation awareness: theory, measurement and application to teamwork (1 ed.) CRC Press LLC,

2009. ProQuest Ebook Central, <https://ebookcentral-proquest-com.ezproxy.library.uvic.ca/lib/uvic/detail.action?docID=476274>.
- Schenk, E., Schleyer, R., Jones, C. R., Fincham, S., Daratha, K. B., & Monsen, K. A. (2018). Impact of adoption of a comprehensive electronic health record on nursing work and caring efficacy. *CIN: Computers, Informatics, Nursing*, 36(7), 331-339. doi:10.1097/CIN.0000000000000441
- Schulz, C. M., Krautheim, V., Hackemann, A., Kreuzer, M., Kochs, E. F., & Wagner, K. J. (2016). Situation awareness errors in anesthesia and critical care in 200 cases of a critical incident reporting system. *BMC Anesthesiology*, 16(1), 4-4. doi:10.1186/s12871-016-0172-7
- Shoham, D. A., Harris, J. K., Mundt, M., & McGaghie, W. (2016). A network model of communication in an interprofessional team of healthcare professionals: A cross-sectional study of a burn unit. *Journal of Interprofessional Care*, 30(5), 661-667. doi:10.1080/13561820.2016.1203296
- Sitterding, M. C., Broome, M. E., Everett, L. Q., & Ebright, P. (2012). Understanding situation awareness in nursing work: a hybrid concept analysis. *Advances in Nursing Science*, 35(1), 77-92. doi:10.1097/ANS.0b013e3182450158
- Sitterding, M. C., Ebright, P., Broome, M., Patterson, E. S., & Wuchner, S. (2014). Situation awareness and interruption handling during medication administration. *Western Journal of Nursing Research*, 36(7), 891-916. doi:10.1177/0193945914533426
- Slawomirski, L., A. Aaraaen & N. Klazinga (2017), The economics of patient safety: strengthening a value-based approach to reducing patient harm at national level", *OECD Health Working Papers*, No. 96, OECD Publishing, Paris

- Sorensen, L. J., & Stanton, N. A. (2016). Keeping it together: the role of transactional situation awareness in team performance. *International Journal of Industrial Ergonomics*, *53*, 267-273. doi:<https://doi.org/10.1016/j.ergon.2016.02.007>
- Stanton, N.A. (2016). Distributed situation awareness. *Theoretical Issues in Ergonomics Science*, *17*(1), 1-7.
- Stanton, N. A., Salmon, P. M., & Walker, G. H. (2015). Let the reader decide: a paradigm shift for situation awareness in sociotechnical systems. *Journal of Cognitive Engineering and Decision Making*, *9*(1), 44-50. doi:10.1177/1555343414552297
- Stanton, N. A., Salmon, P. M., Walker, G. H., Salas, E., & Hancock, P. A. (2017). State-of-science: situation awareness in individuals, teams and systems. *Ergonomics*, *60*(4), 449-466. doi:10.1080/00140139.2017.1278796
- Stanton, N. A., Stewart, R., Harris, D., Houghton, R. J., Baber, C., McMaster, R., . . . Green, D. (2006). Distributed situation awareness in dynamic systems: theoretical development and application of an ergonomics methodology. *Ergonomics*, *49*(12-13), 1288-1311. doi:10.1080/00140130600612762
- Stewart, K. R., & Hand, K. A. (2017). SBAR, communication, and patient safety: an integrated literature review. *MedSurg Nursing*, *26*(5), 297-305.
- Stomski, N., Gluyas, H., Andrus, P., Williams, A., Hopkins, M., Walters, J., . . . Morrison, P. (2018). The influence of situation awareness training on nurses' confidence about patient safety skills: A prospective cohort study. *Nurse Education Today*, *63*, 24-28. doi:10.1016/j.nedt.2018.01.019

- Stubbings, L., Chaboyer, W., & McMurray, A. (2012). Nurses' use of situation awareness in decision-making: an integrative review. *Journal of Advanced Nursing*, *68*(7), 1443-1453. doi:10.1111/j.1365-2648.2012.05989.x
- Tan, T.-C., Zhou, H., & Kelly, M. (2017). Nurse-physician communication - An integrated review. *Journal of Clinical Nursing*, *26*(23/24), 3974-3989. doi:10.1111/jocn.13832
- Taylor, J., Sims, J., & Haines, T. P. (2014). The emergent relevance of care staff decision-making and situation awareness to mobility care in nursing homes: an ethnographic study. *Journal of Advanced Nursing*, *70*(12), 2767-2778. doi:10.1111/jan.12425
- Ten Have, E. C. M., Hagedoorn, M., Holman, N. D., Nap, R. E., Sanderman, R., & Tulleken, J. E. (2013). Assessing the quality of interdisciplinary rounds in the intensive care unit. *Journal of Critical Care*, *28*(4), 476-483. doi:10.1016/j.jcrc.2012.12.007
- Wisner, K., Lyndon, A., & Chesla, C. A. (2019). The electronic health record's impact on nurses' cognitive work: An integrative review. *International Journal of Nursing Studies*, *94*, 74-84. doi:10.1016/j.ijnurstu.2019.03.003
- Wright, A., Sittig, D. F., Ash, J. S., Erickson, J. L., Hickman, T. T., Paterno, M., . . . Middleton, B. (2015). Lessons learned from implementing service-oriented clinical decision support at four sites: A qualitative study. *International Journal of Medical Informatics*, *84*(11), 901-911. doi:10.1016/j.ijmedinf.2015.08.008
- Wright, M. C., & Endsley, M. R. (2008). Building shared situation awareness in healthcare settings. In C. P. Nemeth (Ed.), *Improving healthcare team communication: lessons from aviation and aerospace* (1st ed., pp. 97-114). Burlington, VT: Ashgate Publishing Ltd.
- Zadeh, R. S., Shepley, M. M., & Waggener, L. T. (2012). Rethinking efficiency in acute care nursing units: analyzing nursing unit layouts for improved spatial flow. *Health*

Environments Research & Design Journal, 6(1), 39-65.

doi:10.1177/193758671200600103

Appendix A: Research Information Sheet

Research Study Information Sheet

This study is being conducted by Lynne James. Lynne is a University of Victoria graduate student who is taking the Master of Nursing and Master of Health Informatics Double Degree Program. She is also the Clinical Nurse Specialist for the Critical Care Network in Interior Health.

Every day, critical care nurses gather and share information that is important for patient care. The purpose of this study is to understand how nurses share information in intensive care units. Lynne will be studying the six "W's" of information sharing by nurses. Specifically, **how** nurses share information, **what** information they share, **who** they share it with, along with **where**, **when** and **why** they share the information.

To understand how nurses share information, Lynne will collect information in three ways: 1) Observing nurses, which involves following nurses during a shift, and taking notes when they share information, 2) Interviewing staff, physicians and patients to gain their perspectives on how nurses share information, and 3) Reviewing charts to determine what nursing information is documented by nurses and other healthcare professionals.

When this information is gathered, Lynne will identify factors that assist or prevent information sharing. She will also develop a diagram of how information flows through the intensive care unit.

This study will help us understand how to help nurses gather and share information more easily. For example, it may help us know how to design intensive care units, or where to place phones and computers. It may also help us understand how to develop staff schedules to improve their ability to communicate with each other.

If you have any questions about this study, please contact Lynne James:

Lynne James

Phone: information removed

Email: information removed

Address: information removed

Appendix B: Nurse Consent



**University
of Victoria**



Interior Health
Every person matters

**Participant Consent Form –
Nurse Participant**

Information Sharing by Critical Care RNs in ICUs: An Observational Study

You are invited to participate in a research study entitled **Information Sharing by Critical Care RNs in ICUs: An Observational Study** that is being conducted by Lynne James.

Lynne James is personal information removed:

Phone: Contact information removed.

Email: Contact information removed.

As a graduate student, I am required to conduct research as part of the requirements for a double degree in Master of Science in Nursing and Master of Science in Health Information. It is being conducted under the supervision of Dr. Anne Bruce and Dr. Francis Lau. You may contact my supervisors at:

Dr. Francis Lau: Contact information removed.

Dr. Anne Bruce: 2 Contact information removed.

Interior Health is supporting this research through in-kind donations of staff time to participate in interviews and observations.

Purpose and Objectives

The purpose of this research project is to study how information sharing by critical care RNs influences patient care in intensive care units. A particular focus of the research is to study factors facilitate and hinder information sharing. The objectives of the research are to understand: a) what types of patient information is collected by critical care RNs, b) how, when, where and why this information is shared, and c) how information sharing by critical care RNs influences care decisions and impacts patient care.

Importance of this Research

Research of this type has at least three benefits. First, it improves our understanding of the role of nurses as a source of information for the entire multidisciplinary team. Second, it helps us understand patterns of information sharing that are more or less effective at influencing patient care. Third, it may help to identify factors that impede information sharing so that site leaders may address them.

Participants Selection

You are being asked to participate in this study because you are a critical care RN in one of the participating ICUs. As a critical care RN, your participation will provide insight into how information is shared and used by RNs in the ICU.

In this ICU, four nurses will participate. As well, 4 patients and families and about 2 to 6 other health care providers will take part in the study. This study is happening in one other ICU with the same number of participants.

What is Involved

If you consent to voluntarily participate in this research, your participation will include being buddied with the researcher from 0700-1500. The researcher will observe the types of information you collect and share, and the ways that you share and use that information. You will also be asked questions occasionally throughout the 8-hour period, specifically about your perceptions of information sharing and your perceptions of communication in the ICU. You will also be asked to confirm observations to "fact check" the data collection by the researcher.

Please be advised that information that is gathered for this research study will be de-identified.

Inconvenience

Participation in this study may cause some inconvenience to you, such as the time it takes to answer the questions. This will create a disruption in your workday.

Risks

The risk to participating in this study is that of being identified as a source of information for the study. While no documents that result from this study will include participant names, participants will be identified in documents by profession. As well, you will be seen by staff and patients to be participating in the study and answering questions.

Benefits

The potential benefits of your participation in this research include an improved understanding of the role of nurses as a source and user of patient information, and an improved understanding of information flow in your ICU specifically.

Compensation

While it is against Interior Health policy to provide gifts to employees for the purpose of research, the researcher will provide gift baskets to the entire staff as a thank you for granting permission to conduct research.

Voluntary Participation

Your participation in this research must be completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation. If you do withdraw

from the study your data will be used only if you provide permission. Reports will be generated within 3 months of the date of your participation, so please withdraw within 3 months of your interview.

Researcher's Relationship with Participants

The researcher may have a relationship to potential participants as an employee of Interior Health. To make it easier to decline participation in the study, feel free to provide this information to the patient care coordinator for your unit. She will relay this information to me.

Anonymity

It will be difficult to protect your anonymity fully because the researcher will follow you in the ICU for 8 hours, and staff will see you participating in the study. However, every effort will be made to keep your information confidential, see "Confidentiality" below.

Confidentiality

To give you an opportunity to withdraw your information at a later time, your name will be recorded. Your confidentiality and the confidentiality of the data will be protected by:

- a) Recording your name, profession and ICU on only one document, called a linking key. This is a paper document that will allow your data to be identified indirectly in case you choose to withdraw your information. Only the primary researcher has access to this document.
- b) Storing the linking key separately from the interview data.

Dissemination of Results

It is anticipated that the results of this study will be shared with others in several ways. A written thesis will be placed online with the University of Victoria on "UVicSpace. As well, there will be a thesis presentation, published article, and summary report. The summary report will be provided to the manager of the ICU. Contact Lynne James directly for a copy of the summary report.

Disposal of Data

Data will be stored in a locked cupboard in the researcher's home. Data from this study will be disposed of after five years. Paper documents will be shredded, and electronic documents will be deleted.

Contacts

Refer to page 1 for the individuals to contact regarding this study: Lynne James, Dr. Anne Bruce, and/or Dr. Francis Lau.

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-

472-4545 or ethics@uvic.ca). You may also contact the Chair of the IH Research Ethics Board via telephone at 250-870-4602 or via email to researchethics@interiorhealth.ca.

Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Name of Participant Signature Date

The participant will receive a signed copy of this consent form.

Appendix C: Patient and Family Consent



**University
of Victoria**



**Participant Consent Form –
Patients and Families**

Information Sharing by Critical Care RNs in ICUs: An Observational Study

You are invited to participate in a research study entitled **Information Sharing by Critical Care RNs in ICUs: An Observational Study** that is being conducted by Lynne James.

Lynne James is personal information removed:

Phone: Contact information removed.

Email: Contact information removed.

As a graduate student, I am required to conduct research as part of the requirements for a double degree in Master of Science in Nursing and Master of Science in Health Information. It is being conducted under the supervision of Dr. Anne Bruce and Dr. Francis Lau. You may contact my supervisors at:

Dr. Francis Lau: Contact information removed.

Dr. Anne Bruce: Contact information removed.

Interior Health is supporting this research through in-kind donations of staff time to participate in interviews and observations.

Purpose and Objectives

Every day, critical care nurses gather and share information that is vital for patient care. The purpose of this study is to improve our understanding of how nurses share information in intensive care units. The researcher will study the six "W's" of information sharing by nurses. **How** nurses share information, **what** information they share, **who** they share it with, along with **where**, **when** and **why** they share the information.

Importance of this Research

This research will help us understand how the information that nurses share can improve patient care. It will also help us identify factors that get in the way of information sharing, so they can be fixed.

Participants Selection

You are being asked to participate in this study because you or your loved one is in ICU, and is being cared for by a nurse who participating in this study.

In this ICU, four nurses will participate. As well, 4 patients and families and about 2 to 6 other health care providers will take part in the study. This study is happening in one other ICU with the same number of participants.

What is Involved

If you decide to participate in this research, it will involve answering questions about how nurses share information with you, in a 10-15 minute interview that takes place in your room. This interview will be recorded using hand-written notes. At the end of the interview, the researcher will review your answers with you to ensure that they have been recorded correctly.

As well, once you are discharged from hospital, your chart will be reviewed. I will be reading the documentation of the healthcare team members to identify evidence of information sharing between nurses and other healthcare provider. For example, I will note whether the physician took note of the nursing assessment used it to change a treatment decision.

Inconvenience

Participation in this study may cause some inconvenience to you, such as the time it takes to answer the interview questions. As well, there will be an increase in activity in your ICU room because of the presence of the researcher.

Risks

The main risk of being part of this study is that you could be identified as a study participant. Your name will not be included in any reports that are produced from the study, but people in the ICU will see that you are participating in the study. As well, in order to locate your chart after your discharge, the researcher will have to temporarily collect your name, date of admission, and chart number. This identifying information will be recorded in password protected file.

Benefits

There are no benefits for participants of this study. The potential benefits of your participation in this research include an improved understanding of the role of nurses as a source of patient information. It will also help us understand how information flows through the ICU.

Compensation

As a way to compensate you for any inconvenience related to your participation, you will be given a \$10 gift card to the coffee shop in the hospital. If you consent to participate in this study, this form of compensation to you must not be coercive. It is unethical to provide undue compensation or inducements to research participants. If you would not participate if the compensation was not offered, then you should decline.

Voluntary Participation

Your participation in this research is completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation. Specifically, your medical care will not be impacted in any way. If you do withdraw from the study your data will be used only if you provide permission. Reports will be generated within 3 months of the date of your participation, so please withdraw within 3 months of your interview.

Researcher's Relationship with Participants

The researcher does not take part in your care in any way, so declining to participate in the research will not impact your care.

Anonymity

Interviews will take place in or near the ICU, at your discretion. However, because the ICU is a small area with limited staff, other patients and staff may see you participating in the study.

Confidentiality

To give you an opportunity to withdraw your information at a later time, your name will be recorded. Your confidentiality and the confidentiality of the data will be protected by:

a) Recording your name, date of admission and chart number and any personally identified data on only one document, called a linking key. This is a paper document that will allow your data to be identified indirectly in case you choose to withdraw your information. Only the primary researcher has access to this document.

b) Storing the linking key separately from the interview data.

Dissemination of Results

It is anticipated that the results of this study will be shared with others in several ways. A written thesis will be placed online with the University of Victoria on "UVicSpace. As well, there will be a thesis presentation, published article, and summary report. The summary report will be provided to the manager of the ICU. Contact Lynne James directly for a copy of the summary report.

Disposal of Data

Data will be stored in a locked cupboard in the researcher's home. Data from this study will be disposed of after five years. Paper documents will be shredded, and electronic documents will be deleted.

Contacts

Refer to page 1 for the individuals to contact regarding this study: Lynne James, Dr. Anne Bruce, and/or Dr, Francis Lau.

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca). You may also contact the Chair of the IH Research Ethics Board via telephone at 250-870-4602 or via email to researchethics@interiorhealth.ca.

Your signature below indicates that you understand the above conditions of participation in this study, that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Name of Participant

Signature

Date

The participant will receive a signed copy of this consent form.

Appendix D: Data Collection Form

Appendix E: Interview Guide

Interview Questions

1) How do you receive and provide information?

Follow-up questions:

- a) What is the context of the information exchange?
- b) Where does information sharing take place?
- c) What time of day?
- d) What is the method?
- e) What is the content?
- f) What is the goal of the information exchange?
- g) How do you use this information?
- h) Who do you share information with?

2) What might improve information sharing by nurses?

Follow-up questions

- a) How does the physical design of the ICU influence information sharing?
- b) How do staff schedules influence the exchange?
- c) In what ways do communication styles influence the exchange?
- d) How does technology influence the exchange?

3) How is information sharing supported right now in your unit? What makes it easier for you to obtain and share information?

Follow-up questions

- a) Are their scheduled times for information sharing? Rounds? Huddles? And are they helpful?
- b) Who is your audience for documentation?
- c) What technology do you use to exchange information with nurses? Email, text, phone, fax, communication boards, etc.

Appendix F: Preliminary Analysis for Participant Review

Preliminary Analysis for Participant Review

I am conducting my preliminary analysis, and an important part of this is to “member check” – or show participants early results so that they can agree/disagree/shed more light on the subject. As always, this is completely voluntary, but if you would like to provide feedback, feel free to do so by replying and adding comments to the questions below. Thanks again! I will also send you a summary when the data analysis is complete.

Factors that Improve Information Sharing

- 1) **Trust between colleagues** –nurses expressed that one of the key factors improving communication between colleagues and even between nurses and patients was trust.
 - a) Do you agree with this? If so, why? If not, why not?
 - b) What factors contribute to developing trust between colleagues?
 - c) Is there anything that can be done by your ICU to enhance trust between colleagues?
- 2) **Strong handover** – nurses expressed that thorough handover at shift change was a very important part of information sharing.
 - a. Do you agree with this? If so, why? If not, why not?
 - b. What factors contribute to a thorough handover?
 - c. If there anything that could be done to improve handover in your unit?
- 3) **Interdisciplinary Rounds** – there were mixed feelings about interdisciplinary rounds, some felt that they were very helpful in improving communication between professionals, while others felt that they were very time consuming to prepare for and perhaps not worth it
 - a. Do you believe that interdisciplinary rounds improve communication enough to be worth the time to prepare for them?
 - b. What factors contribute to useful interdisciplinary rounds?
 - c. What could be done to improve interdisciplinary rounds in your unit?
- 4) **Technology**– Vocera was identified as a useful tool for information sharing, however, its usefulness was limited because not everyone signed on to the system
 - a. Can you think of other technologies that assist with information sharing?

Factors that Impair information Sharing by Nurses

1) **Lack of a central place for necessary information** –nurses expressed that a lack of a central place for all pertinent information impaired their ability to receive and share information

a. Do you agree with this? If so, why? If not, why not?

b. What would the ideal central place for nursing information look like? What information would it have?

c. Are there documents or tools in use now that could serve the function of a central repository for information if everyone used it?

2) **Colleagues who do not listen** – several nurses expressed that it was very difficult to share information with specific individuals who spoke over them and did not listen

a. Do you agree with this? If so, why? If not, why not?

b. Think of a person who it is easy to share information with. What are the qualities of that person?

c. Think of a person who it is difficult to share information with. What are the qualities of that person?

d. Are there factors in the ICU (i.e. other than individual factors) that make it difficult for people to listen or receive information?

3) **Physical layout of the ICU** – several nurses expressed that the linear layout of the ICU made it difficult to share and receive information.

a. Do you agree with this? If so, why? If not, why not?

b. Can you think of strategies to improve information sharing in this linear ICU?

4) **Technology** – there was a concern with the visual quality of hallway monitors; the resolution is poor and when an alarm goes off it is difficult to see what vital sign parameter is triggering the alarm.

a. Do you agree with this? If so, why? If not, why not?

b. Can you think of other examples of technologies that impair information sharing?

LYNNE JAMES, BSN, MSc, CNCC(C)

Regional Practice Leader, Clinical Lead ACE Project

Professional Practice Office

Phone: 778.531.6598

Appendix G

Research Ethics Board Approval

Board of Record
Interior Health

3rd Floor 505 Doyle Avenue
Kelowna, BC V1Y 0C5
Tel: 250-870-4602



Certificate of Ethical Approval for Harmonized
Minimal Risk Study

Also reviewed and approved by:

University of Victoria

Principal Investigator: Lynne James	Primary Appointment: University of Victoria	Board of Record Approval Reference #: 2018-19-023-H
Study Title:	Information Sharing by Critical Care nurses in Intensive Care Units	
Study Approved:	09 August 2018	Expiry Date: 09 August 2019
Research Team Members:	Lynne James, Anne Bruce, Francis Lau	
Sponsoring Agencies:	Interior Health in-kind sponsorship	
Documents included in this approval:	UVic Application for Research Ethics Approval BC18-201 Script for explaining the study to potential participants Consent to Contact email v1 Interview Guide v1 Observation Field Notes form Chart data collection form Study Information Sheet Linking Key Consent Form – Nursing Participants v3 Consent Form – Interview Participants v3 Consent Form – Patients and Families v3	

This ethics approval applies to research ethics issues only and does not include provision for any administrative approvals required from individual institutions before research activities can commence.

The Board of Record (as noted above) has reviewed and approved this study in accordance with the requirements of the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans.

The "Board of Record" is the Research Ethics board designated on behalf of the participating REBs involved in a harmonized study to facilitate the ethics review and approval process. In the event that there are any changes or amendments to this approved protocol, please notify the Board of Record.

Board of Record Representative

***Signature removed**

Appendix H
Operational Approval



Research Department

505 Doyle Road
Kelowna, BC, V1Y 0C5
research@interiorhealth.ca

INSTITUTIONAL APPROVAL TO CONDUCT A RESEARCH PROJECT

RESEARCHER: Lynne James

PROJECT TITLE: Information Sharing by Critical Care nurses in Intensive Care Units

IH REB FILE NUMBER: 2018-19-023-H

APPROVAL DATE: September 10th, 2018

This is to inform you that your research project may now be initiated as of the approval date above, and is approved based on the following:

1. The Certificate of Approval dated 09/08/2018 issued by the Interior Health Research Ethics Board.
2. Application for Operational Approval to Conduct Research completed and approval granted.
3. Completion of all contract requirements with final copies received by the Research Department.

The Institutional Approval to Conduct a Research Project will remain in effect as long as the Interior Health Research Ethics Board approval is renewed annually and all amendments submitted are approved as required throughout the duration of this project.

The Institutional Approval to Conduct a Research Project will expire upon the Interior Health Research Ethics Board receipt and acknowledgment of the project closure report.

***Signature removed.**

Appendix I: Site A ICU Floor Plan

Appendix J: Site B ICU Floor Plan

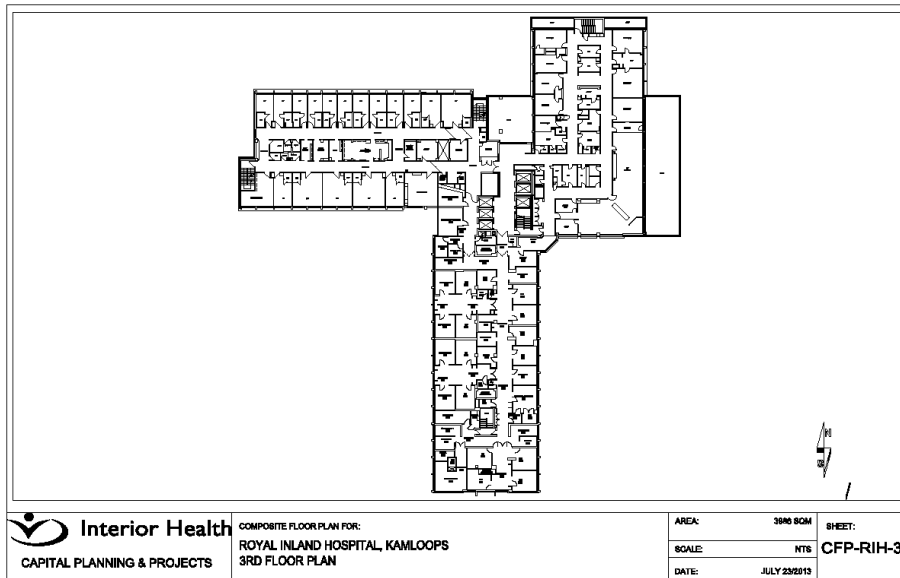


Figure J.1: Third floor plan at Site B. ICU is located in the wing closest to the bottom of the figure.

Appendix K: Information Sources Used by Critical Care RNs

Table K.1. Sources of Information Used by Critical Care Nurses at Site A and Site B during Observation Periods – Equipment.

Information Category	ICU Location	Type of Information Provided
Equipment		
Patient monitor	Patient rooms Hallways	Patient vital signs, cardiac rhythm, and invasive monitoring parameters
IV pumps	Patient rooms	IV fluid, medication, dose and rate of medication administration.
NG pumps	Patient rooms	Rate of nutrition administration
Mechanical Ventilators	Patient rooms	Respiratory rate, fraction of inspired oxygen, peak inspiratory pressure and many other ventilation settings.
BiPap machines	Patient rooms	Respiratory rate, fraction of inspired oxygen, inspiratory and expiratory pressure
Optiflow machines	Patient rooms	Fraction of inspired oxygen and air flow
Sequential Compression Devices	Patient rooms	Often just turned on or off, but may have variable pressure and time length settings
Cooling blanket (for cooling patients post-cardiac arrest)	Patient rooms	Temperature target, patient temperature, and many other device settings.
Suction	Patient rooms	Suction pressure, volume of drainage, type of drainage
Drains	Patient rooms	Volume and type of drainage

Table K.2. Sources of Information Used by Critical Care Nurses at Site A and Site B during Observation Periods – Communication Boards, Sheets and Posters.

Information Category	ICU Location	Type of Information Provided
Communication Boards, Sheets and Posters		
Patient assignments	Fishbowl (Site A) Team Room (Site B)	Nursing patient assignments and key patient information such as isolation precautions, or ventilation requirements
On call listings	Unit Clerk Station InsideNet	Contact information for practitioners on call
Continuous Improvement Boards	Hallway (Site A) Team Room (Site B)	Information related to unit improvement projects
Hand Hygiene Posters	Hallways	Hand hygiene reminder posters
Patient and Room Lists	Workstations	List of patients and their room numbers
Allied Health Service Board	Clean utility (Site A)	List of allied health practitioners on call

Communication boards	Patient room	Lists patient name, nurse's name, the date and time and other important information as determined by the RN

Table K.3. Sources of Information Used by Critical Care Nurses at Site A and Site B during Observation Periods – Paper Resources

Information Category	ICU Location	Type of Information Provided
Forms (all)	Cabinet in 'tube room', unit clerk station and cardiac hallway (Site A) Wall near unit clerk station (Site B) In paper chart (Site A & Site B)	Contain clinical decision support Provide assessment guidance Provide a place for nurses to document care and share information Most frequently used forms include: a) the Critical Care Flowsheet or Record – a comprehensive form that meets most of the documentation needs of critical care RNs, b) Medication Administration Record (MAR) b) Admission history, c) plan of care, and d) kardex, e) physician order forms, f)
Critical Care Flow Sheet (Site A) Critical Care Record (Site B)		Contains check boxes and blank fields for documenting vital signs, intake and output, nursing care, physical and psychosocial assessments; contains clinical decision support for assessing pain, agitation and sedation, delirium, and mobility.
Medication Administration Record		Includes patient identifiers, medication name, dose, route, and times and provides spaces for nurses to sign when medications have been administered.
Plan of Care		An inter-disciplinary record in which care providers develop a patient-specific plan of care relating to different function areas such as mobility, pain management, and bladder management.
Kardex		A central location for patient information including history of presenting illness, diagnosis, allergies, IV fluids, dietary requirements, lab results, insertion dates for tubes and lines.

Admission History		A detailed admission history that includes history of presenting illness, medical issues and surgeries, and drug use.
Physician Orders		Nurses both read and write physician order on these forms. Medications, laboratory tests, and diagnostic imaging are among the many types of orders that can be found here.
Paper Chart	Workstations (Site A / Site B)	A compilation of physician orders, lab results, diagnostic imaging reports, physician progress notes and consultations, previous medication administration and nursing documentation.

Table K.4. Sources of Information Used by Critical Care Nurses at Site A and Site B during Observation Periods – Online Resources

Information Category	ICU Location	Type of Information Provided
Online Resources	Computers at workstations (Site A and Site B) Computers in Pods (Site B)	
Interior Health InsideNet - iSite		Paystubs, job vacancies, vacation and benefit information.
Interior Health InsideNet – Policies and Procedures		Clinical information on medication administration, device removal, etc.
Google searches		General interest information on disease conditions.
Electronic Medical Record		A compilation of physician orders, lab results, diagnostic imaging reports, allied health documentation, some physician consultations, and medication orders (but not administration) for acute care patients.

Table K.5. Sources of Information Used by Critical Care Nurses at Site A and Site B during Observation Periods – Human Resources

Human Resources	Location	Type of information
Patient	Patient room	When possible, history of presenting illness, medical and surgical history, psychosocial history, physical

		and psychological changes, desires for care.
Family members	Patient room, workstation, family room or by phone	When possible, history of presenting illness, medical and surgical history, psychosocial history, physical and psychological changes, relays patient needs and desires for care.
Registered Nurses	Located using vocera or found in the unit (Site A / Site B)	Patient care information, policies, procedures, unit-coordination.
Patient Care Coordinator or Charge Nurse	Located using vocera or found physically in the unit (Site A / Site B)	Hospital and ICU function; admissions and discharges; administrative processes, equipment use, advanced patient care.
Unit Clerk	Located in ICU	Hospital and unit administrative functions.
ICU Physician	Located using the phone or found physically in the unit	Patient-required lab tests, diagnostic tests, procedures and medications.
Physician consultants	Located using the phone or found physically in the unit	Patient-required lab tests, diagnostic tests, procedures and medications.
Respiratory Therapist	Located using vocera or found physically in the unit (Site A / Site B)	Optimal ventilation settings, detailed respiratory assessments.
Physiotherapist	Located using the phone or found physically in the unit	Optimal mobility practices
Social Worker	Located using the phone or found physically in the unit	Local resources to provide to patient (often the social worker connects patients and families with

Appendix L: Forms and Pamphlets used by Critical Care RNs



Figure L.1: A single copy of all of the forms and pamphlets used by ICU nurses at Site A. Nurses use these documents to share information with staff and patients.

Appendix M: Information Sharing between Study Nurses and Others in the ICU

Table M.1: Information sharing events between study nurses and the people RNs most frequently interact with.

	RNs	Patient	Family	Physician	Patient Care Coordinator
VN1	12	10	6	7	3
VN2	16	5	2	4	2
VN3	64	12	16	6	--
VN4	21	15	6	8	5
RNa	26	30	10	4	4
RN2	15	9	19	6	3
RN3	13	29	12	2	1
RN4	25	6	5	2	3

	Respiratory Therapy	Consultants	Physiotherapy	Pharmacist	DI Technicians
VN1	1	2	4	0	0
VN2	0	0	0	0	0
VN3	6	0	0	0	3
VN4	0	0	5	3	0
RNa	1	3	7	1	3
RN2	4	2	0	1	0
RN3	3	1	0	1	1
RN4	2	2	2	1	0