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Nurses' Learning and Conceptualization of Technology used in Practice

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A thesis submitted in partial fulfillment of the requirements for the degree in Doctor of Philosophy

Nurses' Learning and Conceptualization of Technology used in Practice
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by

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Abstract

How nurses conceptualize and learn about health technology used in practice was examined in this qualitative, interpretive-descriptive study. Traditionally, conceptualizations of technology used in the nursing profession have been viewed from either socially- or technically- centric perspectives that have clouded the real nature of nurse-technology interactions. For instance, current perspectives examining nurses' use of technology typically ignore or minimize socio-technical considerations impacting technology acceptance and adoption by nurses. A research approach that embraced the mingling of social and material (sociomaterial) actors was used to address the following research questions: (a) *How do nurses conceptualize health technology used in practice?*, and, (b) *How do nurses learn about health technology used in practice?* The theoretical lens of Actor-Network Theory (ANT) provided the overall perspective and guided elements of data collection and analysis. ANT is aligned to a relational ontology, whereby both human and non-human participants (or actors) are viewed in symmetry (or as equals) during data analysis. Privilege during the analysis was, therefore, not automatically prescribed to either the human or non-human actors. Interviews, documents, and direct observation of nurses constituted the majority of the data collected for this study. Using an iterative data analysis process, themes were generated related to nurses' conceptualization of and learning about technology used in practice. Technology was conceptualized by nurses to possess variation in naming, roles, and also engendered notions of action or praxis. Learning technology by nurses possessed elements resembling both processes and products. From these learning processes and products, salient strategies (e.g., indispensability, semblance, habituation) were developed by nurses in order to negotiate and use various health technologies for practice. Ultimately, learning of health technology by nurses appeared to actively influence, modify, and shape the role of health technology, and its subsequent use by human actors. Therefore, how nurses learn about technology should be considered during the planning, development, and evaluation of future technologies. End-users, like nurses, will rarely use a health technology to its fullest capability unless learning is congruent with the environmental context surrounding the technological actor. In light of these findings, recommendations for nursing education and professional practice related to the role and interpretation of health technology used by nurses in 2013 is also discussed, along with implications for future research.

Keywords

Technology, informatics, nursing, nursing education, conceptualization, learning, Actor-Network Theory, sociomaterial, socio-technical, social media, adoption, use

Co-Authorship Statement

Richard G. Booth completed the following work under the supervision of Dr. Mary-Anne Andrusyszyn and Dr. Carroll Iwasiw, and, advisement of Dr. Lorie Donelle and Dr. Deborah Compeau. All supervisors and advisors will be co-authors on publications resulting from the chapters of this dissertation.

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Chapter 1 - Introduction

Nursing has had a long history of using computerized technology to support practice, starting in the 1960s with the development and introduction of hospital information systems to assist with basic information exchange requirements (Saba & Erdley, 2006). Over the course of the next few decades, the power and functionality of technology used by nurses grew exponentially in all areas of the health system. With the wider scale introduction of various health informatics and electronic health (eHealth) technologies in the late 1990s, the Canadian health system began a fundamental evolution from traditional paper-based modalities of information transfer to those underpinned by electronic communication. Although nursing had developed a significant body of literature examining informatics and technology by this time, collectively the profession has been slow to adapt the skills, knowledge, and competencies required to implement and lead technologic innovation in a changing health system environment (Nagle, 2007).

To address this gap within the profession in regards to informatics, nursing scholars began to develop programs of research dedicated to examining computer and technological competencies during the late 1990s and around the turn of the century (Nagle & Clarke, 2002; Staggers, Gassert, & Curran, 2002). In the early 2000s, nursing researchers began to publish reports that examined various core competencies (e.g., computer literacy, informatics knowledge and skills) and purported to be a "comprehensive list of informatics skills and knowledge for nurses" (Staggers, Gassert, & Curran, 2001, p. 308). Staggers et al. (2001) proposed four levels of informatics competencies for nurses based on the findings of a comprehensive Delphi study examining the skills, competency, literacy, and knowledge related to informatics used by

nurses. Although the work of Staggers et al. (2001; 2002) was influential in building awareness related to informatics competencies in the profession, the relevancy of some of the competencies became quickly outdated due to the exponential growth of and generational familiarity with technology.

During the same time period the increased power of computer, mobile technologies, and the ubiquity of the Internet within the consumer sphere began to gain more visibility in the nursing profession. Reports and studies outlining the functional use of Web 2.0 and social media platforms like blogs and wikis began to appear within the nursing education literature (Maag, 2005). In educational settings, the use of handheld technology, high-fidelity simulation mannequins, and virtual reality technologies gained popularity among many schools of nursing. At the same time, healthcare organizations (e.g., long-term care facilities, hospitals, public health, etc.) underwent immense changes in relation to digital technology and health informatics implementations. Significant funds were allocated in the early 2000s to Canada Health Infoway (*Infoway*), the Canadian strategic investor of health technology, from the Canadian Federal government to stimulate the development of a pan-Canadian Electronic Health Record (EHR) (Health Canada, 2009). Correspondingly, many healthcare organizations used these funds to assist in the implementation of electronic health records and other health information and communication technology in clinical settings. By December 2008, *Infoway* had nearly 249 electronic health record projects underway across Canada, with an overall investment value of over 1.5 billion dollars (Regina Qu'Appelle Health Region, 2008).

One factor suggested by *Infoway* to be slowing the wider scale adoption of EHRs during this time period was clinicians' reluctance to accept and adopt health technology. According to *Infoway*'s (2006) *End User Acceptance Strategy* document:

> End users – physicians, nurses, pharmacists and other health care practitioners – are the people who must make the [technological] solutions work in their everyday activities in hospitals, clinics and communities. They are the people who must adopt and properly use these modern health information systems and communication technologies. (p.1)

Although most of the directive undertones (e.g., "must") used previously by *Infoway* in respect to clinician technology adoption has been removed from their policy documents (as of 2013), *Infoway's* underlying perspectives of technology adoption remain unchanged. From *Infoway's* 2005-2006 annual report, clinician adoption of technology was viewed as a key determinant in decision-making about funding arrangements:

> Clinician adoption [of health information systems] is used as one of the key measures of success, and is used to "gate" funding in all major projects. A portion of the funds does not flow to the relevant province or territory until the agreed-upon levels of clinician usage have been achieved. (2006b, p. 20)

More recently, *Infoway* (2011) reiterated that the "most difficult challenge in addressing human factors in the EHR and telehealth adoption…is the engagement of clinicians" (p. 34). *Infoway* also posited that the value proposition, training, and heterogenic composition of end users needed "greater understanding [in order to] significantly ramp up adoption" of various eHealth technologies used by clinicians (p. 34).

This focus on clinician adoption of technology was also represented in the evaluation frameworks proposed by *Infoway*. In 2006, *Infoway* proposed a *Benefits Evaluation Framework for Health Information Systems in Canada* (Lau, Hagens, & Muttitt, 2007) based on DeLone and McLean's (1992; 2003) seminal works from the Information Systems literature examining factors that promote information system success or effectiveness. As part of this evaluation framework, clinician technology adoption was measured by *System Usage* (or use) along with other hypothesized dependent variables that affected information system effectiveness (i.e., *System Quality, Information Quality, Service Quality, User Satisfaction,* and *Net Benefits*). Within the *Infoway* Benefits Evaluation Framework (Lau, Hagens, & Muttitt, 2007), technology use by clinicians was proposed as an important variable since it was conceptualized as a predictor of the benefits derived from use of a technological system (e.g., increased productivity, quality, and access elements). Although this evaluation framework continues to serve as a lens through which to examine specific technological innovations in healthcare, the notion of technology (system) usage by clinicians is poorly defined in the *Infoway* model. To date, *technology usage*, as conceptualized by the *Infoway* model (Lau, Hagens, & Muttitt, 2007) has been largely theorized as an outcome variable predicted by factors related to both the user and their immediate environment (e.g., effort required to use system, usefulness of system, social influence, etc.). The two major theoretical models informing and reinforcing *technology use* as a dependent variable originated from widely-cited models of technology acceptance, including the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Utilization of Technology (UTAUT) (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989; Venkatesh, Morris, Davis, & Davis, 2003). The greatest concern regarding the use of these

frameworks in nursing stems from the largely binary perspective in which *technology use* is conceptualized (e.g., used or not used). Similarly, the importance of various extraneous social and technical factors is typically minimized in models developed from the Davis et al. (1989) and Venkatesh et al. (2003) lineage. Though the TAM and UTAUT were significant works at the time of their publication, critics of these perspectives have suggested caution regarding their use for present day examinations of technology adoption and use (Benbasat & Barki, 2007; Despont-Gros, Mueller, & Lovis, 2005).

Despite the documented limitations of these models, the TAM and UTAUT models continue to be used as guiding frameworks for researching health technology use within nursing and health care settings (Ammenwerth, Mansmann, Iller, & Eichstädter, 2002; Chang, Hwang, Hung, & Li, 2007; Edwards, 2006; Holden & Karsh, 2010; Howard, 2009; Rahimi, Timpka, Vimarlund, Uppugunduri, & Svensson, 2009; Schaper & Pervan, 2007; Zhang, Cocosila, & Archer, 2010). According to Orlikowski (2007), although models like the TAM and UTAUT have provided significant insights into the role and function of technology in organizational settings, the models become problematic when viewing technology and its use by humans from broader ontological perspectives. A key weakness of diffusion-based approaches like the TAM and UTAUT is that "technology is treated as a matter of interest only in certain particular organizational circumstances" (Orlikowski, 2007, p. 1436). These types of approaches generally privilege either the human (socially deterministic) or technology (technologically deterministic) perspective instead of examining the entire complex entanglement of "the social and the material…in everyday life" (p.1437).

Orlikowski (2007) suggests that the reluctance to examine the complex entanglement of the social and material (sociomaterial) has impeded larger conceptualizations of technology and its use by humans. In order to overcome this theoretical oversight, Orlikowski recommends examining the relationship between technology and humans from a *sociomaterial* perspective. A sociomaterial perspective endorses the complex entanglement of social (e.g., humans, culture, organizations, etc.) and the material (e.g., technology, systems, tools, equipment, 'things,' etc.) actors in everyday life. The sociomaterial perspective views "the social and the material [as being] inextricably related — there is no social that is not also material, and no material that is not also social" (p. 1437). Therefore, privilege in the relationship is not automatically granted to either a social or technical actor; rather, both the social and technical are considered to be "*constitutively* entangled in everyday life" (Orlikowski, p. 1437).

With the increased application of techno-centric models like TAM and UTAUT to nursing research, a deeper understanding of nurse-technology interactions is required to ensure the profession does not limit its conceptualization of technology use to that of a linear cause and effect relationship. Currently, many nursing researchers still seem complacent toward enacting this constricted view of technology within their research and evaluation. For instance, it is still common to find studies and articles in the nursing literature outlining how *technology impacts nurses* (Callen et al., 2013; Cornell et al., 2010); it is less common to find studies or reports examining how *nurses impact technology*.

Therefore, using a sociomaterial perspective to examine nurses' use of technology is an important first step to broaden the understanding of how nurses learn and use health

technology in practice. Throughout the remainder of this chapter I describe the growing divisions between how technology is conceptualized, learned, and ultimately used by nurses in practice. I also outline potential insights for this current state, and conclude with the study's overall purpose and objectives.

Background

Definition of Health Technology

For operational considerations within this research, the term *technology* has been drawn from the branch of nursing literature which emerged in the late 1960s, which examines the use of computer technology and information systems (and later, informatics and eHealth). Therefore, although it is respected that *technology* can be conceptualized as activities or objects other than computerized innovations (Barnard, 1996), for the purposes of this study, the word *technology* refers to systems, devices, and innovations that are non-human and underpinned by computerized processor function.

Over the years, various terms have been used to denote this aforementioned form of technology within the profession. *Computers, information and communication technology (ICT), systems, innovation, informatics, eHealth, Information Technology (IT)* and many other descriptors have been popular. Given the current breadth of computerized technology that exists within nurses' work and education environments, the term *technology* is used as the primary noun to describe a multitude of non-human actors enabled by computerized function. Examples of technology might include the Internet, handheld devices, automated blood pressure machines, wireless communication devices, websites, and software programs. It was deemed important to leave the operational

definition of technology as broad as possible to determine what nurses *conceptualize* as health technology. Therefore, the only constraints placed upon the operational definition of *technology* were that it is non-human and underpinned by computerized processor function.

To assist in further clarifying aspects of technology, in this study the term *health technology* was used when discussing the topic of technology used by nurses in nursing roles (i.e., leadership, education, research, and practice). Although this decision could be viewed as a constraint on the emergent definition, it was important to ensure nurses reflected upon technology that can be used for health(care) purposes.

Relational Ontology

As described in the preceding sections, a sociomaterial approach to examining the entanglement of technology and nurses is unique as it challenges traditionally espoused ontologies of separateness. According to Sandelowski (1997a), a significant weakness in the nursing literature is that technology is treated "as a monolithic entity, with no differentiation made among the diverse technologies used by nurses over time and for different purposes" (p. 172). The failure to conceptualize a key actor (i.e., technology in this case) in its evolving sociomaterial relationship with humans has reinforced the presumption of separation between these two entities (Orlikowski & Scott, 2008) in the healthcare context. This division has further reinforced traditional conceptualizations, and more importantly, modes of evaluation including the examination of social aspects of technology use separate from technical systems and artifacts (Orlikowski & Scott, 2008).

Although the presumed separation between nurses and technology has likely been reinforced by traditional evaluation methods, Sandelowski (1997b) believes that the English language may also be partly to blame. She states that "English language customs make it difficult to convey the human-technology relation as other than one of us/it and cause and effect" (p. 222). This point is also reinforced by Orlikowski and Scott (2008) who state that due to the dominance of social and techno-centric perspectives in research, "we lose the possibility of seeing the technical and social as inextricably fused" (p. 463). Like Sandelowski, they claim that the continued examination of the social and material separately stems from a linguistic issue; language customs demand differentiation between people and technological actors when examined collectively.

The ontological separation of social actors from the technical actors as described above is not a new phenomenon. There have been numerous scholars (Berg, 1999; Berg, Aarts, & Der Lei, 2003; Callon, 1986; Coiera, 2004; Latour, 2005; Law & Hassard, 1999; Law, 2007; Mol, 2002) over the last two decades who outlined their alignment to a *relational ontology* instead of an *ontology of separateness* when examining the relationality of humans and technology (Orlikowski, 2010). Unlike the dualism that appears when examining the social and technical separately, a relational ontological perspective rejects a world composed of "individuals and objects [with] separately attributable properties that exist in and of themselves" (Orlikowski, 2010, p. 134). A relational ontology fully appreciates the mingling, entanglement, and merging of various social and material actors.

Relational Ontology and Learning

One construct that is significantly influenced by this relational perspective is *learning*. Typically, the action of *learning* is cast at the individual level whereby the locus of control related to learning is individually sponsored. From a relational ontological perspective, *learning* is thought to be stimulated by the environment and underlying socio-technical structures, rather than being purely driven by the individual (Fox, 2009). Learning theories and perspectives like cognitivism typically position learning as individually sponsored, cognitive process. For instance, cognitivist perspectives of learning would impart that learning is a process carried out by the learner, in which knowledge is developed over time by building on past learning (Mastrian, McGonigle, Mahan, & Bixler, 2010). During the learning process, various mental processes are enacted (e.g., insight, memory, and perception) in order to build a schema of linked concepts and meanings. Over time, this schema builds and assimilates new experiences into the existing schema to generate new understandings of the phenomena around the learner (Mastrian et al., 2010). Constructivism is not a specific learning theory, but a philosophy of learning. This perspective would support that learning is something that is intimately internal, whereby the actual learning occurs as a process constructed by the individual and the surrounding social environment, rather than a collection of linear experiences fused together (Mastrian et al., 2010).

Newer approaches inspired by elements of post-structuralism and other theoretical perspectives like Actor-Network Theory frame *learning* not as an individually-based cognitive action or process, but as a social and cultural interpretation of the sociomaterial context around the learner (Usher & Edwards, 2007). Learning within this perspective is

aligned with the underlying social and cultural contexts that generate the opportunity for the learning instance. Similar to social constructivism, the learner in a sociomaterial perspective is situated within a larger network of other actors where action takes place. Due to his/her positioning within this larger environmental context, the learner becomes positioned into the *learner* role (Usher & Edwards, 2007). Further analysis of this learning perspective will be provided and integrated with the discussion of the overarching theoretical framework of the study, Actor-Network Theory, found in Chapter 3.

Recasting Learning of Technology in a New Light

The reliance of individualistic and constricted approaches exercised by nursing researchers conducting informatics research has resulted in a body of knowledge that largely minimizes the contextual importance of intermediary actors (e.g., environment and context) involved in the process of learning to use technology. This shortcoming, replicated over numerous years of informatics research, has resulted in a poor understanding of the foundational elements required to encourage and support technology use by nurses. Similarly, the construct of *learning* has been historically conceptualized as an *a priori* intermediary in the process of technology usage, rather than a dynamic product of the human-technology relationship. Popular behaviour-intention models of technology acceptance and usage (e.g., TAM, UTAUT) continue to reinforce this a priori positioning of learning without providing reflection as to how *learning* was originated, actualized, or evolved over time.

Within this research study, the learning undertaken by nurses to use technology is not examined from an individualistic, cognition-based approach as proposed in the

behaviour-intention models. Rather, learning is understood as a set of practices shaped by a larger system (Gherardi & Nicolini, 2000), which is ultimately actualized and exercised by individuals or groups of individuals in specific patterns of action. Therefore, learning is not conceptualized as an attribute that exists exclusively at the individual level or driven solely by the individual. *Learning* by nurses with respect to technology is framed as being stimulated by other powerful actors, within a larger environmental system, that prescribe a pattern of action and behaviour (Fox, 2009; Usher & Edwards, 2007).

Statement of Problem

The continued reliance on deterministic perspectives to both delineate and evaluate how nurses use technology neglects the complexity of the environment and the context in which nurses and technology exist. Currently, research in nursing continues to investigate *nursing* and *technology* separately, instead of building new interpretations of nurses' interwoven relationships with technology. This failure to appreciate the sociomaterial process of nurses using technology has impeded the growth of new perspectives that examine how nurses conceptualize and learn about health technology. The recent adoption of models like the TAM and UTAUT in the profession and its literature has served to reinforce the disconnectedness between nurses and technology during evaluation. This constrained view of the interwoven relationship between technology and nurses needs to be addressed in order to generate deeper understandings of how nurses learn and use health technology.

Study Purpose and Research Questions

As outlined in the earlier section of this chapter, health technology has been historically viewed by nurses in constrained fashions with little consideration given to the sociomaterial context in which nurses and technology exist. Little research has been conducted in the nursing profession to examine the sociomaterial milieu of nurse-technology interactions, from both conceptual and learning perspectives. To address this issue, I use a sociomaterial perspective in this study to assist in transcending the previously described, constricted understanding of nurse-technology interactions. The purpose of this study, therefore, is to examine *how nurses conceptualize and learn to use health technology in practice*. The theoretical lens of Actor-Network Theory (described in Chapter 3) is used to support an emergent analysis that subscribes to a sociomaterial perspective.

To further access some of the finer sociomaterial examples of nurse-technology interaction, two study research questions were generated from the main purpose of the study:

(a) how do nurses conceptualize health technology used in practice?

(b) how do nurses learn about health technology used in practice?

Study Significance

The purpose of this study is to highlight the sociomaterial experiences and processes encapsulated by nurses' conceptualization of and learning about health technology used in practice. The results of this study could assist in reframing how

technology is learned, used, and evaluated within the profession. The current pathways of technology evaluation in nursing (and healthcare for that matter) need to be reconceptualized in order to be relevant in the coming decades. Therefore, using non-traditional perspectives like sociomateriality to deconstruct examples of nurse-technology usage is not only timely, but necessary to address methodological weaknesses of certain research processes that purposefully ignore or minimize the importance of certain actors due to their instability, reclusiveness, or dynamic nature. To this end, it is intended that the findings of this study further the development of awareness and functional insights toward the sociomateriality of nurses and technology within practice. Finally, the intention of this study is to share the awareness and insights gained with the current and future generation of nurses, educators, researchers, and leaders so the true functionality of health technology can be leveraged for clinicians and consumers alike.

Overview of Chapters

The format of this dissertation follows the monograph format as outlined by the School of Graduate and Postdoctoral Studies at Western University. In Chapter 1, the introduction, background, purpose, and significance of the study are outlined. Chapter 2 is a literature review of various nursing technology topics relevant to the dissertation as a whole. Chapter 3 contains details related to the methodology and theoretical underpinnings of this study. Actor-Network Theory is applied as the theoretical lens in this study and details regarding its interpretation and operationalization within the research process have been presented in this chapter. Chapters 4, 5, and 6 form the research findings sections of this dissertation. Chapter 4 details the findings that address the first research question of how nurses conceptualize health technology used in

practice, while Chapter 5 addresses how nurses learn about health technology. In Chapter 6, strategies related to nurses' learning health technology are explored. In the final chapter in this dissertation, the study findings are synthesized, and recommendations for future nursing education, practice, and research related to health technology are offered.

Chapter 2 – Literature Review

In this chapter, I present a comprehensive review of the literature that examines topics related to the use of technology within the nursing profession. Although far from exhaustive, a detailed summary of the current philosophical perspectives and empirical evidence related to the use of health technology in the nursing profession is provided. Search terms included *technology*, *electronic*, *informatics*, *ehealth*, *social media*, *information and communication technology*, and *internet* were searched in combination with various *nursing* related terms (e.g., nurse, nursing, clinician) using scholarly databases (i.e., CINAHL, Medline, SCOPUS, and Google Scholar). Searches of databases for information systems and health informatics literature were also conducted. Search terms such as *technology adoption*, *technology use*, *information systems*, *sociomaterial*, *socio-technical*, *relational ontology*, *translation*, and *Actor-Network Theory* were used and articles collected when topically relevant to the study.

Given the exploratory and expansive nature of both the research questions and the theoretical lens used in this study, minimal constraints were placed upon the discipline or profession of origin from which studies and articles originated. Both expository and research articles were included in the review, all from peer-reviewed journals. No date parameters were set on any of the search terms used due to the self-limiting nature of the research questions and subject matter (i.e., study of computerized technology in nursing did not exist prior to the 1960s). Articles and studies not written in English were excluded from this review.

Article databases CINAHL, Medline, SCOPUS, and Google Scholar were used to locate relevant literature. Similarly, the SCOPUS and Google Scholar "cited by" functions were used to obtain other relevant and more recently published articles. All literature was collected and organized using the reference management software Mendeley (Mendeley Ltd, London, UK). Mendeley allows sharing of various electronic documents and abstracts between registered users. Using the social sharing functionality of the program, a *crowd sourcing* (Henning et al., 2010) strategy was implemented to identify and access a number of articles pertinent to this study, either through the online search functionality of Mendeley, or, shared directly by other colleagues. Similarly, this software provides a user the ability to search and track the pervasiveness of research articles held by other Mendeley users. This ability to search articles via readership metrics of the larger than two million Mendeley user population (Henning, 2012) resulted in the ability to find relevant articles and papers that other users archived in their databases.

Given the breadth and variety of topics related to technology and nursing, a wide range of relevant articles, studies, and reports spanning nearly four decades are summarized in this chapter. In all, 36 research studies, 30 expository articles discussing various interpretations and conceptualizations of technology, and six policy/regulatory documents related to informatics were included in this literature review. These selected works serve a twofold purpose: (a) to sensitize the reader to the larger lineage of scholarly work completed in relation to nurses using technology; and, (b) to explore the current-day perspectives of technology and its positioning in the profession.

The layout of the literature review is largely chronological, in order to orient the reader to both the historical evolution of the subject matter, but also to impart an understanding of the *current state* of nurses using technology in education and practice. In the latter half of the literature review, a historical perspective of how nurses conceptualize and learn health technology used in the profession is examined.

Technology in Nursing Education

Within the Canadian nursing education system, baccalaureate entry-to-practice for new registered nurses is common in most provinces and territories (Quebec, Manitoba, and the Yukon being the exceptions) (Canadian Nurses Association, 2011). As part of an undergraduate education, awareness and familiarity with informatics and technology content is a competency in nursing education curricula. The College of Nurses of Ontario (2008) outlined that new graduates entering the profession should understand "the significance of nursing informatics and other information and communication technologies used in health care" (p. 10) for the purposes of "managing nursing and health care data" (p. 5). More recently, the Canadian Association of Schools of Nursing (CASN) and Canada Health Infoway (*Infoway*) (2012) refined entry-to-practice competencies for registered nurses related to informatics. Subsequently, students in baccalaureate nursing education are required to receive informatics content during their education in order to ensure new practitioners are able to effectively use information and communication technology to deliver evidence-informed care to patients and clients (CASN-*Infoway*, 2012).

Although the formal ratification of competencies related to informatics has been a relatively recent addition to nursing education, research related to technology and

informatics use in education has been ongoing for nearly four decades. The first reports of computer assisted instruction (CAI) in the nursing literature began to emerge in the early 1970s. Carol, Collart, and Ertel (1972) outlined the potential of CAI in nursing education, describing the various teaching and learning interactions required to provide high quality learning opportunities for students. They stated that the chief limitation of this type of teaching technology was that "CAI is just emerging from the laboratory…[and] there are unknowns associated with employing a computer as a learning method because not enough time has yet been invested in the development of CAI to permit adequate experimentation and evaluation" (p. 2036). The authors concluded that "CAI is not held out as a panacea…[as] it is a promising form of educational technology whose potential is closely related to some of nursing's most pressing needs" (p. 2039). Work in CAI continued onwards into the 1980s, where it became a popular topic within the nursing education literature. The excitement in this novel educational modality was reiterated in affirmative statements like those outlined by the American Nurses Association in 1986. According to Nehring and Lashley (2009), the American Nurses Association claimed that "CAI allowed nursing students to learn more efficiently than they can in the classroom" (p. 533). In their historical review of the topic, Nehring and Lashley stated that CAI had numerous advantages for nursing education, which included enabling a student to work independently, normalizing a set of common expectations for students, and cost-effectiveness. Regardless, like many other technologically infused learning tools, the most significant drawback of this learning modality was that the development of instruction material was extremely time consuming.

Although not as old as CAI, electronic mail (later, more commonly known as email) was first studied by nurse educators in the late 1980s (DeVillier, 1988; Staggers, 1989; Staggers & Jacox, 1990), and arguably could be one of the most impactful technological advances in nursing education to date. Over the last 20 years the use of email in educational settings has evolved from a rudimentary communication alternative, into a requisite personal identifier and communications access point for students and academic faculty alike. Around the same time as the rise in popularity of email (corresponding with improvements in software, hardware, and availability of the Internet), wider scale implementations of computer-conferencing (CC) technologies (e.g., Blackboard, FirstClass, and WebCT) began to emerge in nursing education. Cragg (1994) demonstrated the first usage of CC within nursing education in her qualitative examination of seven post-RN students who undertook a course delivered through CC. Since Cragg's example, there have been numerous other examinations of CC in the education literature, peaking in popularity in the early 2000s. Many examinations of CC in education focused on student attitudes and perceptions related to the system, its usability, or the associated learning outcomes (Ali, Hodson-Carlton, & Ryan, 2004; Booth, Andrusyszyn, & Iwasiw, 2011; DeBourgh, 2003; Mancuso-Murphy, 2007; Twomey, 2004). For instance, Babenko-Mould, Andrusyszyn, and Goldenberg (2004) examined nursing students' self-efficacy in terms of nursing competencies learned through CC. They found increases in students' efficacy with CC at the end of a 12-week pre-post study, in both the non-CC and CC groups. Valaitis, Sword, Jones, and Hodges (2005) conducted a qualitative study examining CC use in nursing student populations in an online problem-based learning class. Students found the workload of the asynchronous learning environment challenging and required an adaptation period to

acclimatize to the learning modality. Overall, authors found that the CC medium allowed for flexible delivery, but cautioned that adaptation time and proper student technological training is required for smoother delivery. Atack and Rankin's (2002) results were similar to Valaitis et al. in terms of students' need for technological skills preparation. Overall, Atack and Rankin found that most of the nursing students who took their 16-week course via CC were highly satisfied by the online learning modality.

Along with the rise of CC in nursing education during this decade, parallel efforts were made by researchers to map the diffusion of computerized technology within and across nursing education. Carty and Rosenfeld (1998) published findings from an American national survey of nursing schools to determine the status of computer and information technology in education. Their survey of 347 schools of nursing sought feedback regarding the following content areas: (a) technology inventory; (b) computer and technology in the nursing curriula; (c) existence and effectiveness of technological innovations; and, (d) descision-making and policy implications. At the end of the four month data collection period, the researchers had received responses from 190 schools (55% response rate). It was reported that less than half of nursing faculty at the surveyed schools had computers (48.9%), yet almost all respondents stated that student access to computers was present (97.8%). Access to electronic resources like CINAHL in libraries were proportionally higher in baccalaureate programs (83.5%) than in either diploma (64.3%) or associate (55.2%) programs. Similarly, CAI was a popular educational outlet for technology at this time period. Roughly 71% of schools surveyed by Carty and Rosenfeld stated that they required students to utilize the CAI platforms as part of their education. Informatics content in the curriculum was found to be extremely low, with less than one third of schools reporting any content of this type infused into curricula.

A study completed by Nagle and Clarke (2002) a few years later examining the educational informatics needs of Canadian schools of nursing found surprisingly different results than those reported by Carty and Rosenfeld (1998). The researchers found that universal access to school information and communication technology (ICT), including Internet, email, and computers was nearly 100% among faculty. Student access to school related ICT was at a far lower rate (roughly 20%). Similarly, they also found a discrepancy between faculty's access to research databases (75%), versus students' access (51%). Furthermore, students were sometimes burdened by levee fees for usage. Beyond the discrepancies in access between faculty and students, 41% of the schools surveyed reported that classrooms in the educational setting were ill-equiped to utilize ICT in educational delivery. Only 47% of the schools reported having some element of distance education available for students, typically for supporting other courses like pathophysiology. The schools reported that only about one-third of their faculty had "good to very good" knowledge regarding nursing informatics competencies.

As the Nagle and Clarke (2002) report outlined, the infusion of technology into nursing education was typically a clumsy endeavour in the late 1990s and early 2000s, evidenced by the lack of supportive information technology infrastructure, the lack of faculty preparation, and the lack of wide scale diffusion across schools and curricula. Concurrently, there was a sizable push in the education sector during the early 2000s to evaluate the effectiveness of outfitting students with mobile technologies for educational purposes. Although it is unclear where the impetus to implement mobile technologies in nursing education originated, it is likely partly due to the increased availaibilty of

portable devices and to the growing realization of the importance of information technology in modern healthcare delivery.

Reports emerging from researchers around this time period provided varied examples of faculty attempting to insert technology (typically in the form of laptops or personal digital assistants) into the educational pedagogy of students (Demb, Erickson, & Hawkins-Wilding, 2004; Mennenga & Hendrickx, 2008). For instance, Birx, Castleberry, and Perry (1996) conducted a study to test the utilization of laptops in an undergraduate nursing course. The experimental group (n=20) was given laptops and participants used them for email, library searches, personal use, and word processing. There was no significant improvement in computer knowledge between the comparison groups (who were not given a laptop or specific computer training). Regardless, the experimental group demonstrated improved computer skills while maintaining a positive attitude toward computers in nursing. Other reports outside nursing education literature spoke to the need to weave technology such as laptops into the fabric of university education in a seamless fashion. Campbell and Pargas (2003) suggested that educators needed to learn to adapt lesson plans in order to integrate laptop technology into classes. Similarly, Campbell and Pargas suggest that laptops used in education needed to become "effectively invisible" (p. 99) in the teaching-learning process.

As the excitement and functionalty regarding technology in nursing education began to cystalize in the middle part of the 2000s, a new generation of policy related to technology began to emerge. In 2006, The Canadian Nurses Association released a seminal stragetic vision for the future of technology in nursing with the *e-Nursing Stratgety for Canada* document. This document outlined current and projected trends for

nursing education, and included a call to increase the readiness of students and faculty for elearning modalities, and to increase the incorporation of rich media (e.g., video and animation), virtual reality, blogs, wikis, portals, and mobile technologies to nursing education.

Although the term *e-Nursing* as proposed by the Canadian Nurses Association (2006) does not seem to have been adopted as a term in nursing education vernacular, many of the projections outlined in the *e-Nursing Stragety for Canada* report did reflect the increasing technological savviness of many nurse educators and students. For instance, by 2005 Web 2.0 and social media technologies were beginning to emerge in response to the evolving potential of the Internet and related communication technologies in commercial and consumer sectors. Web 2.0 or social media generally refers to online services that are created, manipulated, and customized by Internet users, using an array of input devices (e.g., laptops, mobile devices, etc.)(Gray, 2011). Blogs, wikis, and social networking sites (e.g., Twitter, Facebook) would be considered *social media* applications. Due to the increased popularity and uptake of social media by consumers by 2007-2008, nursing educators began publishing articles and reports that outlined the functionalities and potential uses of social media technology for nursing education. One of the first attempts by a nursing researcher to examine a social media platform was conducted by Maag (2005) who evaluated blog use by undergraduate nursing students. Since then, nursing researchers have undertaken other examinations of social media technology including the use of podcasts (McCartney, 2006; Skiba, 2005), wikis (Bastida, McGrath, & Maude, 2010; Boulos, Maramba, & Wheeler, 2006), and most recently, social networking sites like Facebook, YouTube, and Twitter (Bristol, 2010; Hansen & Erdley, 2009; Russell, 2009; Skiba, 2007). Fraser (2011) published the first book related to

social media in nursing in early 2011, and most recently there was a special issue dedicated to the topic of social media in nursing from the *Online Journal of Issues in Nursing* (September 2012).

Along with the rise in popularity of social media as a tool in education, the use of high-fidelity simulation equipment in nursing education was integrated into and also gained traction in schools of nursing. High-fidelity simulation is described by Hicks, Coke, and Li (2009) as the "use of a technologically advanced computerized mannequin" (p. 1) to simulate structured learning experiences for students in a safe and efficient manner. Proposed as a safe and cost-effective alternative learning strategy for students to build competency related to clinical skills, high-fidelity simulation equipment has entered nursing education and become an important teaching-learning tool in many educational programs (Alinier, Hunt, Gordon, & Harwood, 2006; Blum, Borglund, & Parcells, 2010). Like many of the themes found in the CC literature, research findings from simulation studies tend to focus on various perceptual and technical attributes of how students use the technology. For instance, Lasater (2007) published an account of using simulation equipment and its effect on student clinical judgment. She found that students' use of the simulation equipment reinforced learning, in the way that it translated book and lecture knowledge into practical skills. The use of simulation also provided an opportunity for faculty to observe students' clinical judgment in action, and provide insight and productive coaching (Lasater, 2007). Blum, Borglund, and Parcells recently conducted a quasi-experimental study examining the relationships between student self-confidence and clinical competence. They found no significant differences in clinical self-confidence and competency between groups utilizing the traditional learning methods and those using the simulation equipment. A recent systematic review of simulation use in

nursing education by Cant and Cooper (2010) concluded that this learning approach might have an advantage over other strategies, but is largely dependent on context and method. In their review of 12 experimental or quasi-experimental studies that examine nursing simulation, Cant and Cooper remark that the constructs of student knowledge, critical thinking, and learner satisfaction all typically increase due to use of the simulation equipment.

Virtual reality is also an increasingly popular method for nurse educators to infuse technology into education. Much like immersive video games (e.g., World of Warcraft®, or Diablo III®), virtual reality platforms allow a user to control the actions of an avatar in a virtual online environment. Through this avatar, a user is able to manipulate, interact, socialize, and participate in features and with objects contained in the virtual environment. One such virtual reality platform that has become commonly used in nursing education is Second Life®. Second Life has been used to replicate or provide students with the ability to reinforce through practice various clinical and interpersonal situations in a safe and contained environment. For instance, McCallum, Ness, and Price (2011) explored students' decision making skills regarding virtual patient care situations. These researchers found the students were more reactive to emergent issues in the simulated situation, rather than proactive in their care planning. The authors concluded that decision making skills are difficult to learn and that Second Life could provide an innovative platform for practice in developing these clinical skills. Similarly, Schmidt and Stewart (2010) developed a Second Life-enabled public health office to help familiarize students with public health settings. Students were able to complete a number of mediated activities including restaurant inspection, virtual support groups, and disaster scenarios created in the virtual communities of Second Life. Finally, Sweigart, Hodson-

Carlton, Campbell, and Lutz (2010) completed a study with 201 sophomore nursing students where they had to conduct 30 minute interviews with standardized clients via Second Life. They found that 82% of the students reported the virtual setting to be conducive to practicing interview skills. Although the majority of the students reported a positive experience, the authors stated that some of the students felt they did not have enough time to complete the interviews. Similarly, the researchers also proposed that competency with "typing skills" (p. 262) may have impacted the abilities of some students and their time management.

Technology in Practice

Practice-based health technology has been a focus of many researchers since the introduction of computerized systems into health environments in the early 1960s. During the 1960s and 1970s, the first computer-enabled technology for use in patient and client care began to see wide scale use in nursing practice. The increased availability of microcomputers and the development of functional computerized mainframes resulted in an explosion of interest in the topic during the 1980s (Saba & Erdley, 2006). During this decade, portable point-of-care devices like electronic intravenous pumps and automated blood pressure machines also began to appear in clinical areas. By the 1990s, computerized technology in the practice environment had become a standard for many acute-care clinical areas. The increasing prevalence of the Internet and related technologies by the late 1990s ushered a new generation of communicative processes and their corresponding devices into practice settings (e.g., wireless communication, Bluetooth enabled point-of-care devices, and wireless Internet).

Today, the technology used in nursing practice ranges tremendously in variety, purpose, and functionality. Common areas of evaluation revolve around the increased use of electronic medical records (EMR) to replace (or supplement) the paper-based record systems traditionally used by clinicians. For instance, evaluation of the effectiveness of EMRs has been an ongoing effort by nursing researchers over the last decade (Saranto & Kinnunen, 2009; Urquhart, Currell, Grant, & Hardiker, 2009). Generally, time saved and quality of reporting have been the metrics of interest when EMRs were examined. Ammenwerth et al. (2001) examined the use of computer-based nursing documentation in a two-month randomized control trial. Overall, they found that time savings were not achieved in the nursing group provided with the EMR system, versus those who continued to use traditional paper-based charting. Donati et al. (2008) found that nurses and other clinicians using an EMR saved time during documentation and increased the overall quality of documentation. Lee, Mills, and Lu (2008) examined the impact of a nursing documentation system on the clinical practice of nurses. In their year-long follow-up, they discovered that nurses spent roughly 30% of their time documenting, and that the implementation of an electronic record actually *increased* the amount of time required to document adequately. The authors purport that there were probably several factors contributing to this increase in documentation time, including the learning time required by the nurses to understand the system and a lengthy system implementation process.

Computerized provider order entry (CPOE) systems have been another ripe area of exploration for nursing researchers. Cordero, Kuehn, Kumar, and Mekhjian (2004) examined the use of a CPOE system with nursing populations in their study of medication errors in an academic health centre. They found that the implementation of a

CPOE system into their NICU area resulted in a reduction of both medication dispensary delays and the frequency of medication errors. Unlike Cordero et al., Ulanimo, O'Leary-Kelley, and Connolly (2007) found that medication errors continued to persist with the implementation of a sophisticated CPOE system. The authors concluded human factors (including clinician-developed workarounds) and nurse fatigue were two of the primary perceived reasons medication errors persisted. In a study conducted by Koppel et al. (2005), the CPOE system actually generated new types of medication related errors or risks. In their longitudinal mixed-method study examining CPOE use in an academic teaching hospital, they found a number of human and technical-related risks and errors (e.g., delayed ordering due to downtimes of CPOE, uncertainty about medications due to numerous CPOE screens, etc.) that had gone largely unnoticed by staff.

Barcode verification and positive patient identification systems have also been studied with nurses over the last decade. Van Onzenoort et al. (2008) studied compliance of nurses using barcoding technology in practice at a Dutch hospital. During the duration of the study, the authors reported that only 55.3% of all medication administrations (N=23,492) were barcode verified. The researchers stated that a number of nurses developed workarounds; those adaptations combined with a lack of a receptive attitude to the system may have contributed to the low compliance rates. Poon et al. (2008) examined barcode verification from the perspective of nursing process, before and after the implementation of the barcoding technology. The researchers found that after completing both pre-post time motion studies and direct observations (e,g., tracking the movements and work processes of nurses) of 116 observation sessions that there was no significant difference in the time required to administer and verify a patient's identifications and medication.

Other areas of technology routinely examined by nursing researchers include point-of-care devices like personal data assistants (PDAs), tablet computer technology, and wireless voice communicators. Stroud, Smith, and Erkel (2009) examined the use of PDAs by nurse practitioners. From their survey, they found that of the 124 nurse practitioners who responded, 79 (64%) used a PDA in practice. Drug referencing material and dosage calculators were important applications that were used by 90% of the 79 nurse practitioners sampled. A significant majority of the overall sample (98%, n = 121) perceived the PDA as a valuable tool for the nurse practitioner clinical role. Doran et al. (2010) found similar results in terms of the PDA applications most commonly used by nurses during practice. In their longitudinal study of the impact of PDA and tablet computer usage by 488 nurses, nurses most frequently used these devices to access medication reference information, Internet search engines, and best-practice guidelines. The authors concluded that although no significant improvements were found in terms of nurses' job satisfaction and the perceived quality of care provided in relation to the PDA/tablet usage, they posited that the potential for these devices to assist clinical decision-making was still promising.

Technology Conceptualization

Along with the numerous evaluations of nurses' use of various technology as presented above, another important area of scholarly discourse has focused on defining and conceptualizing the technology used in the nursing profession. Over the last three decades, nursing academics have generated a formative body of knowledge that discusses, describes, and conceptualizes the actor of *technology* used by nurses or for

nursing work. One early attempt at conceptualizing technology as used by nurses is Birckhead's (1978) definition:

> The word technology itself is not new, but the impact of such a phenomenon and its implications for nursing has yet to be understood. Technology includes both methods and machines. It is defined…as a self-conscious organized means of affecting the physical and social environment, capable of being objectified and transmitted to others, and effective largely independent of the subjective dispositions or personal talents of those involved. (p. 16)

Birckhead's description and definition of technology serves as an interesting artifact in nursing informatics literature. Her understanding of technology as being comprised of both *methods* and *machines* is a broader conception of the topic, as well as its potential impact upon the profession. A decade later, Cox, Harsanyi, and Dean (1987) also outlined the impact of technology on nurses, while emphasizing the permanence of technology's presence:

> Nurses no longer have a choice regarding involvement with computerization. Involvement is here. Each of us, after a few thoughtful moments, can identify several areas where computerization has already had an impact on our lives. Personal areas of impact include bank accounts, magazine subscriptions, and nursing license renewal. In the work area are such impact aspects as patient monitoring, diagnostic examinations, time and attendance records and pay roll. For the majority of nurses this involvement has been of an insidious and unconscious nature. We became involved without being aware of our

> involvement and with particular unawareness of the impact computerization would have on our future. (p. 3)

Although Cox et al.'s (1987) perspectives were more forcefully presented than Birckhead (1978), both observations of technology within the profession speak to the emerging changes that had occurred due to increased computerization.

As the profession continued to use more and varied types of technology in the 1980s and 1990s, the nature of the discussion in relation to the conceptual understanding of technology became more theoretical and philosophical. For instance, Barnard (1996) outlined that definitions of technology used by nurses in the mid-1990s seemed to be influenced significantly by both ontological and epistemological factors from inside and outside the profession. According to Barnard (2002), theoretical conceptualizations of technology have largely manifested as dichotomous in the literature and practice. For instance, Barnard describes a dualistic *humanities-based* versus *engineering-based* ontology of technology. Barnard describes the humanities perspective of technology to be a potential array of "critical examination[s] of technology, and is positioned in opposition to the more hard-edged economic and technocratic view of the world that dominates much of current research and literature" (p. 18). This humanities-based perspective endorses various social constructivist ideals including the importance of social environments and forces in shaping the conception and use of technology. The humanities perspective also draws on the idea that the division between human and technological action is *blurred* and that technology engenders change at the social level, and conversely, that technology is changed and shaped by social context. Alternatively, an engineering-based perspective of technology typically aims to "identify the nature of

technology as it is manifested through human affairs" (p. 17). This perspective is generally pro-technology in the way that technology is generally viewed from a functionalist or mechanical stance, which seeks to outline a singular or monolithic essence of technology. Barnard (2002) also concluded that due to the predominance of the engineering perspective in nursing research and scholarship, the profession as a collective needed to continue to develop alternative philosophies of nurse-technology relationships.

Sandelowski (1997a; 1997b; 2002) also provided different, yet related, perspectives that align with Barnard's (2002) *engineering-based* constructions of technology in nursing. Using the concepts of *technological optimism* and *technological romanticism*, she outlines the division between two perspectives. She claims that technological optimism endorses the idea that technology assists in extending human observation and clinical skills by way of nurses who begin to describe themselves using machine terminology. According to Sandelowski (1997a), technological optimists highlight the harmony between humans and technology by using terminology such as "technological caring" and the "symbiosis of nurse and machine" (p. 170) to reinforce their positions. The optimist approach contrasts with what Sandelowski describes as technological romanticism, a more socially deterministic perspective of technology whereby clear distinctions between the human and the technological are delineated. Romanticists retained the notion that nursing could not be automated and promoted caution to anyone who would suggest such a notion. A goal of many of authors aligned with the romanticist perspective was to "preserv[e] the essence of nursing [e.g., nurse-client therapeutic relationship] in a technological age" (p. 171). In many ways, to the

romanticist, technology was largely incompatible with the traditional essence of nursing. Although optimist and romanticist perspectives still exist within the profession, their presence as a salient force in the vernacular and literature has become less obvious over time. As Almerud et al. (2008) outlined in her work examining the use of technology in intensive care units, "[t]he machine need not dominate the 'clinical gaze'. One does not have to interpret a patient according to the readings of the machine. Care and technical are not inherently at odds" (p. 135). From Almerud et al.'s comments, it would appear that elements of both the optimist and romanticist perspectives are still active, but appreciation for their mingling and blurring has more resonance than a decade ago.

Although the overt description of authors embracing either optimist or romanticist perspectives appears to be on the decline in scholarly literature, the push to define a concept of technology in nursing continues unabated. Many present-day authors writing on the topic have generated an affinity toward describing the embedded nature and the increasing invisibility of technology in the profession. One recent example from McGonigle and Mastrian (2012) in their nursing informatics textbook outlined technology as:

> [A] method by which people use knowledge and tools. Knowledge used to solve problems, control and adapt to our environment, and extend human potential. Generally people use technology to refer to machines or devices such as computers and the infrastructure that supports them. A simplistic example, examining cell phones and planes – they are technology that are tangible – one can see and touch them but cannot see and touch the vast infrastructures supporting them such as the wireless communications between the device (cell

> phone) and the cell towers nor can one see and touch the electronic guidance used by the device (plane) to navigate the skies. (p.476)

McGonigle and Mastrian (2012) seem to incorporate many of the idea espoused by authors like Barnard (1996), Birckhead (1978), and Cox et al. (1987) (e.g., physical presence and environment, ontology, etc.), but also extend conceptions to reference the many *unseen* technologies that underpin the visible systems. Although a seemingly minor detail, the recognition of the duality of technology (i.e., in both hidden and visible forms) is an important advance for the discussion of technology used by nurses. The conceptual advance is a significant step away from the construction of technology as a monolithic entity by both technological optimists and romanticists, as described by Sandelowski (1997a). The growing appreciation that *technology* exists in different dynamic and emergent forms is vital to ensure perspectives of technology in the profession do not become stagnant or hegemonic with time.

Learning About Technology

Although the nursing literature includes reports on learning-related attributes with respect to technology, the direct examination of how nurses *learn* about technology is remarkably sparse. Generally, nursing scholars have approached the topic of technology learning by categorizing and validating high-level products of a learning process – namely, skills and competencies. This behaviourist or cognitivist approach to examining how nurses learn about technology is well reported in the nursing literature. Some of the first publications in the nursing informatics literature related to *competencies* began to emerge in the late 1980s, with the works of Grobe (1988) and Bryson (1991), but

floundered during the 1990s due to a lack of consensus in the field "regarding the general composition of NI [nursing informatics] competencies" (Staggers, Gassert, & Curran, 2001, p. 304). To address this void in the literature, Staggers et al. presented a cognitivist-based framework to informatics and technology competencies in nursing. The authors of this now seminal work outlined four levels of practice for nurses in the informatics discipline (i.e., Beginning Nurse, Experienced Nurse, Informatics Nurse Specialist, and Informatics Innovator) comprised of various competencies that sequentially built upon each other and culminated in the highest *Informatics Innovator* knowledge level. The competencies addressed in the work of Staggers et al. had a resounding effect in nursing informatics literature, and spawned a lineage of other works based on the authors' definition of nursing informatics and the corresponding competencies listings (Curran, 2003; Gassert, 2008). The influence of this work is still felt in current informatics publications and competency listings. The recently released Canadian Association of Schools of Nursing (CASN) and *Infoway* (2012) collaborative document, *Nursing Informatics: Entry-to-Practice Competencies for Registered Nurses,* uses the work by Staggers et al. as a "key resource" (p. 2), and is one of only seven publications cited in the final version of the document. Currently, CASN-*Infoway* (2012) proposes skills and competencies required for entry-to-practice in relation to informatics including aspects related to foundational skills (e.g., device use or application use), information and knowledge management, professional and regulatory accountability, and information and communication technology.

Although not as popular as behaviouralist and cognitivist approaches to describing learning, constructivist perspectives have been utilized to describe technological learning. Berings, Poell, and Gelissen (2008) outlined various themes

related to how nurses perceive on-the-job learning about health-based technology. In their grounded theory study of 20 Dutch nurses, Berings et al. discovered that nurses found learning computer skills to be important and requisite in their roles; the authors mapped this skill to a theme titled the *technical-practical* domain of nursing. They proposed that learning computer skills was also thematically related to learning other skills, like knowledge of pathology and medications, and information exchange. From the education literature, Ali, Hodson-Carlton, and Ryan (2004) examined graduate nursing students taking a CC course and the process behind their learning. Students stated that the CC platform created an engaging environment that increased levels of collaboration among students. Students outlined that various conditions facilitated their learning, conditions which included the flexible online environment that helped to foster multiple modes of student learning, independence, and autonomy. For instance, it was noted in the analysis by Ali et al. (2004) that students appreciated that the online nature of the course delivery allowed for varied methods of instruction including case scenario deconstructions and debates.

Summary and Gaps

The body of literature related to technology use in nursing is extensive, and multidimensional. Regardless, as outlined in Chapter 1, much of the literature that examines the technology used in the profession continues to do so from a constrained ontology, treating technology as a static feature in the evaluation, or worse yet, "as a monolithic entity" (Sandelowski, 1997a, p. 172). The failure to appreciate the evolving relationship between technology and humans (Orlikowski, 2010) has impeded the

development of potentially new methodologies to evaluate how technological tools assist nursing practice.

Although the nursing literature is filled with examples of technology use, there are few empirical examinations of how nurses conceptualize these forms of innovation. As outlined, many of the theoretical conceptualizations of technology to date have not been addressed since the late 1990s. Given the massive amount of change and evolution that has occurred in the last decade, both in the education and practice sectors, it is important that current conceptualizations of technology be further explored and researched. Without updated perspectives of what constitutes *health technology* in 2013 (and beyond), scholars may recycle archaic perspectives and ideals that no longer adequately represent current day practice.

Correspondingly, there seems to be a lack of knowledge about how technology is learned. Traditional behaviourist or cognitivist approaches have yielded numerous competencies and skills purported to be relevant to nurses in terms of learning about technology. Proponents of these two dominant perspectives have preferred to utilize cause-effect logic, and controlled for variables that were found to be troublesome to measure or codify. Reframing learning from a larger, more dynamic perspective may assist in broadening the understanding of how nurses learn about technology and may potentially offer new insights into future evaluation methods. It may also lead to changes in nursing education curricula with regard to nursing students' integration of technology into their practice.

As outlined in Chapter 1, a sociomaterial perspective may offer a functional lens through which to address many of these previously unaddressed weaknesses in the

literature to date. Although this perspective is far from a panacea, it may assist researchers in generating new and timely insights into technology use by nurses. Further discussion of sociomaterial perspectives and their implications for this study will be explored in Chapter 3.

Chapter 3 – Methods and Theory

The purpose of this study was to examine how nurses conceptualize and learn to use health technology in practice. Stemming from this purpose statement, two specific research questions were developed: (a) how do nurses conceptualize health technology used in practice? and, (b) how do nurses learn about health technology used in practice?

In order to address the purpose and research questions, Actor-Network Theory (ANT) was utilized as a theoretical lens to provide the vocabulary and perspective to describe human-technology interactions. Although other approaches could have been used (e.g., Complexity Theory, or Social Construction of Technology Theory), ANT was selected because of its focus on tracing connections between various actors (both human and non-human) and has been found to be a "useful lens for studying non-linear change and the unintended outcomes of technology projects" (Greenhalgh & Stones, 2010, p. 1288). Along with ANT's functionality in tracing networks, this perspective also provides a lexicon and an ontological stance that allows human and non-human actors to be viewed and analyzed symmetrically. Other theoretical approaches commonly used in nursing research tend to be based on humanistic paradigms or to diminish the importance and agency of non-human actors. The following sections of this chapter describe the theoretical perspectives of ANT and the various research methods used in the study.

Actor-Network Theory

Actor-Network Theory (ANT) was introduced to the social sciences during the mid-1980s by Bruno Latour and Michel Callon (Walsham, 1997), and was used as the theoretical lens in this study. The term *actor* is typically used to denote "both human beings and nonhuman[s] such as technological artifacts" (Walsham, 1997, p. 468), that interact within networks of other actors. According to Lower (2006), an *actor* is either a human or non-human entity (e.g., pencil, automobile, computer, etc.) that possesses the ability to perform action. From the perspective of ANT, the ability to act "does not reside in the entity, but is located in the relationship between entities" (Lower, 2006, p. 97). Subsequently, when actors work together in larger collectives, *networks* between discrete actors can be established to encourage certain actions. *Networks* are collections of actors that form, align, and entangle with each other for the purposes of accomplishing actions or tasks. When various actors come together, they mutually negotiate through a process called *translation* to determine the agency and importance of individual actors in a developing network (Callon, 1986). If actors are able to align and function in unison, a stabilized network may form (Walsham, 1997). One stable network is a *Blackbox network*, which is a collection of actors who work together in such a fashion that at a distance, they look like one actor rather than multiple actors working in synergy (Lower, 2006). In order for actors to undertake various programs of action in networks, *inscriptions* – a way of codifying meaning – of their roles and behaviours need to be developed. As a key tenet of ANT, inscriptions are critical in the development and translation of actor-networks. Subsequently, the following section will help elucidate the role and purpose of inscriptions in ANT.

Inscription. An *inscription* is a process that ascribes meaning to artifacts to protect an actor, or actors', interests (Wickramasinghe, Bali, & Tatnall, 2007). In most ANT studies, inscriptions "are mostly technical artefacts or texts, but can also take the form of contracts, institutions, practices, routines or skills" (Lower, 2006, p. 101). An inscription also represents an "item of apparatus or particular configuration of such items which can transform a material substance into a figure or diagram" (Latour & Woolgar, 1986, p. 51). The material substance, as a "figure or diagram," becomes recognizable and visible by other actors, which can be used to shape an evolving network. As a result, inscriptions can include a wide-range of entities or practices that embody and convey certain patterns of use and meaning to other actors (Hanseth & Monteiro, 1998). For example, texts are popular inscriptions as they present various actions or behaviours in precise, irrefutable ways (Wickramasinghe et al., 2007). This notion of irrefutability is especially evident in instructional material like operating manuals and service documentation related to non-human actors like computers, automobiles, and aircraft.

Inscriptions generally do not work in isolation – they are usually created by actors who hope to attract, entangle, and mobilize other inscriptions that might help to build a more stable and aligned network of diverse interests by formulating a "program of action" for users (Hanseth & Monteiro, 1998, p. 98). For example, a scholarly paper is an excellent example of a collection or "cascade of inscriptions" (Dambrin & Robson, 2009, p.10). The authors of an academic report use other references and sources (i.e., other inscriptions) to align their audience's opinions about why their study findings were relevant and important. By creating such consensus, "inscriptions make action at a

distance possible by stabilizing work in such a way that it can travel across space and time and be combined with other work" (Wickramasinghe et al., 2007, p. 323).

As Dambrin and Robson (2009) note, inscriptions are typically valued for their stability, but are not impervious to changes in the network of actors. For instance, inscribed patterns of behaviour or programs of action may or may not be followed by intended or assigned users. Similarly, the assigned users of a specific inscription might deviate purposefully (or unconsciously) from the instructions contained in the inscription depending on the robustness, flexibility, or irreversibility of the inscription. Therefore, inscriptions can present or demand patterns of use of the actors they represent in a variety of fashions. When actors and inscriptions come together and begin to form a mutually negotiated network, this increased alignment of various actors and inscriptions is called *translation*. The process of translation can be thought of as the "recognition and drawing-in of reciprocal 'interests'" (Dambrin & Robson, 2009, p. 9).

Translation. Translation was broken down into four processes by Callon (1986). He purports that the four stages of translation include: (a) problematisation; (b) interessement; (c) enrolment; and, (d) mobilization of allies. The *problematisation* stage revolves around bringing together actors with a common interest. During this stage, a primary or dominant actor begins to establish itself and becomes a gatekeeper (or an Obligatory Point of Passage, OPP) between other actors and inscriptions in the forming network. This gatekeeper role or OPP becomes a salient player in the network and eventually becomes so robust that the role becomes indispensable in defining the interests at hand, and in modifying other actors and their respective inscriptions to align with the OPP's interests. *Interessement* involves the primary actor initiating the translation

process to convince or appease other actors that their defined roles in the newly emerging network are feasible and acceptable. *Enrolment* occurs when actors begin to align themselves to their defined roles as outlined for them in earlier stages of the translation process. As enrolment occurs, actors begin to accept and represent the roles and interests defined for them during the OPP. The *mobilization of allies* is the final, iterative stage of translation. Actors in this stage reflect upon their journey and reaffirm that their identified roles fit with the other actors in the network. If this translation process occurs successfully, then the stabilization and formalization of an actor-network occurs in the ranks of the actors. The stability of an actor-network can be challenged or compromised at any time, depending on the wishes or reactions of the various actors. Therefore, even though an actor-network might establish and appear at face value to be robust, a change in alliances or a shifting alignment between actors can cause networks to become unstable, collapse, or reform in different patterns. Similarly, although the process of translation might appear to be linear, it is extremely reflexive and non-static. In essence, actors and their respective inscriptions have autonomy within the network and possess agency within the network establishment.

Blackbox network. As previous outlined, a Blackbox network is a stabilized actor-network that acts like "a single actor from the perspective of other actors" (Lower, 2006, p. 98). Along with appearing from a distance to operate as a single actor, Blackbox networks also seem to be infallible when observed generating action. For instance, an automobile, a laptop computer, and even a scholarly paper could all be considered Blackbox networks. When Blackbox networks function properly, their stability is generally not questioned or critiqued. However, if an actor critical to the stability or functionality of a Blackbox is compromised, the entire structure of the network may

become unstable, as the various actors in the network begin to be represented again as individual entities. For instance, a published academic report could be considered a Blackbox network. Various other actors and their respective *inscriptions* work together to build a formable network, which in this example is the completed and published report. The report contains numerous inscriptions of other actors (e.g., references to other studies, notations of the authors' credentials, organizational affiliations, etc.) to denote the importance of the scholarly work, and its potential irrefutability. Therefore, the other inscriptions listed in the report work to reinforce the overall importance of the report, and subsequently at a distance, the collection of actors appears to an outsider to function as one large, single actor (i.e., Blackbox network). It is only upon closer scrutiny that the individual actors that comprise the overall report are *seen*. Furthermore, if one of the other studies referenced in the report is found to have fabricated results (and the study is subsequently retracted from academic literature), the overall strength and credibility of the report may be weakened due to its proximity to the retracted study. Therefore, although Blackbox networks typically present as formative and robust processes, the repositioning or shifting of actors in the Blackbox can cause the dismantling of the network in favour of new actors or a new alignment of previously enrolled actors.

Alignment to Sociomateriality. A key element that differentiates ANT from other traditional research lenses is that neither human nor non-human actors are privileged during the analysis of the network; instead, both human and non-human actors possess agency (Latour, 2005). ANT views "the social and the technical as being enmeshed in a network built to achieve the networker builder's goals" (Elbanna, 2009, p. 7). As outlined in Chapter 1, Orlikowski (2007) recommends aligning to a sociomaterial

perspective when examining human-technology interactions. Since "the social and the material [are] inextricably related" (Orlikowski, 2007, p. 1437), ANT is a useful lens from which to deconstruct situations where both human and non-human actors interact in a dynamic fashion.

Along with endorsing a sociomaterial perspective, ANT also provides a framework for a researcher to examine various motivations that individual or groups of actors might possess, and how they form associations, bonds, and linkages among a diverse network of spatially aligned interests (Walsham, 1997). Given the dynamic nature of actors within networks, proponents of ANT advise against attempting to fix actors to predefined scales or levels of observation (e.g., micro or macro). Latour (1991) states that, "[t]he socio-technical world does not have a fixed, unchanging scale, and it is not the observer's job to remedy this state of affairs" (p. 119). Therefore, actors are free to move between levels and structures, a movement "induced by the actors themselves," and any attempt by the researcher to fix an actor to a static location "is not only dangerous, but simply unnecessary" (Latour, 1991, p. 119).

Within healthcare, there are numerous situations where human and material actors come together to generate action. For instance, nurses using smartphones or computerized devices within professional practice are examples of human and technical actors coming together in the process of network building. These human-material interactions are rarely discussed or analyzed within health sciences or nursing research. Therefore, in order to further accentuate the value of the ANT perspective for deconstructing complex sociomaterial scenarios, two descriptive examples are provided in the following sections. The first example will demonstrate how ANT can be used to

trace networks of actors through the deconstruction of a commonplace non-human actor (i.e., an automobile), suffering from a failed sparkplug in its engine. The automobile/sparkplug example will also illustrate how the dynamic nature of the sparkplug actor and its inscription facilitate action in the translation process. The second example provided in this chapter will explore a healthcare based scenario where nurses are mandated to learn a new smartphone technology to complement their professional practice responsibilities. Using this example, a focus on the translational process of the various actors in the situation will be presented.

Automobile/Sparkplug Example

A localized example of a Blackbox network could be conceptualized as the function of an automobile. For instance, there are hundreds of various parts (actors) that function together to create the actor-network that is known as an automobile. On any given day, all the various parts of the automobile work together in a subscribed manner for things to happen (e.g., turning the ignition starts the automobile). If one of the actors that make up the automobile (e.g., a sparkplug) fails to work properly, the actor-network can become weakened or compromised. A small (relatively, in terms of physical size and the cost of the whole automobile) actor like a sparkplug can halt the collective action of many other actors, including a human, from completing a task they set out to do (e.g., drive somewhere). Since automobiles generally work when called upon, all the hidden processes of the elemental actors that make up the actor-network (i.e., the automobile) are Blackboxed. Only when this larger actor-network stops functioning (e.g., the car does not start when the ignition is fired) do the individual actors start to emerge from the

Blackbox, and actors begin to show their individuality and strength, or weakness, within the network.

When the sparkplug operates properly (and as inscribed), its mobilization of other actors in the immediate network is largely predictable and Blackboxed (e.g., the automobile starts when the ignition is turned; the human driver is able to drive to the desired destination). However, the failure of the sparkplug quickly interrupts the past processes and routines that were familiar when the automobile operated normally. The sparkplug's failure not only halts the collective action of the Blackbox network (e.g., normal function of the automobile), but it also mobilizes other less accessed, yet related, peripheral actors and networks. The tow truck, automobile repair shop, sparkplug wrenches, sparkplug manufacturer, and the automobile manufacturer (to list a few) are all other linked actors that are potentially mobilized by the sparkplug and its demise. In this way, the sparkplug is able to *move* between levels of observation and become a salient actor on different local and global scales, for different reasons. The conceptualization and value of the sparkplug, as ascribed by other actors in the larger network, enables its movement to different levels of observation. For instance, on a more global level, the tow truck company and automobile repair shop may secretly endorse sparkplug failures as they provide a predictable source of billable labour for repair services. To the sparkplug manufacturer, the premature failure of one of its products might be a significant concern in terms of past or present manufacturing quality control. Since the sparkplug manufacturer is probably reliant on sales of this product to sustain profitability, reports of faulty sparkplugs would be of great concern. On an immediate local level, the human attempting to drive the stricken automobile might not possess the mechanical knowledge to understand why the automobile failed. To the human driver, the failure of

the sparkplug represents the collective failure of the automobile to operate as inscribed by past behaviours and experiences. Fault in this case may be prematurely attributed to the automobile manufacturer for building an unreliable vehicle, rather than the sparkplug, which was the impetus of the malfunction. In this way, the dead sparkplug found in the automobile is part of (and the result of) the larger and more complex networks of sparkplug manufacturing, quality testing, repairs services, automobile manufacturing, and an individual's desire to drive somewhere. In all these cases, the sparkplug is viewed as able to modify and negotiate its own strength, importance, and *position* within the network respective to other actors also contained in the network. In essence, the sparkplug is able to move between levels and structures as required to mobilize and enroll specific actions.

Process of Translation. It is apparent that there are numerous actors that are potentially important in the presented automobile/sparkplug situation. The sparkplug, the human driver, tow truck, automobile repair shop, automobile manufacturer, road system, and the sparkplug manufacturer are just a few of the actors of possible interest. Prior to the failure of the sparkplug, these intermediary actors were rarely considered during the normal operation of the automobile. Upon failure of the sparkplug, the established Blackbox network (i.e., the automobile) is compromised and the individuality of its actors opened to scrutiny. At this stage, *translation* of the individual actors into a new network is required in order to solve the immediate problem of the failed automobile. This negotiation between actors to create a new network undertakes four specific stages as previously described: problematisation, interessement, enrolment, and mobilization of allies (Callon, 1986).

The *problematisation* stage commences when the actors' interests are framed by a problem or situation that requires action (Wickramasinghe et al., 2007). For example, upon realizing the automobile has failed, the driver might call for a tow truck in order to obtain assistance in repairing the automobile. Both the driver and tow truck operator have a *common interest* in fixing the failed automobile – although the impetus for this common interest might be different (e.g., the driver wishes to drive somewhere while the tow truck operator wishes for financial remuneration for services provided). Given the driver's lack of diagnostic and technical knowledge, the tow truck operator takes on a dominant role in the evolving relationship between actors. The tow truck operator becomes indispensable to the solution of the current problem (i.e., the failed automobile) because of her adept knowledge of automobile mechanics and her ability to transport the automobile to a more advanced diagnostic facility (i.e., automobile repair shop). The driver allows his role (and interests) in the evolving relationships with other actors (e.g., the failed automobile, tow truck, automobile repair shop, failed sparkplug, etc.) to be prescribed by the tow truck operator. In essence, the driver chooses the primary actor of the tow truck operator (and subsequently, her tow truck) to act on his behalf. The original problem of the failed automobile has begun to be *translated* in such a way that the solution offered by the tow truck operator becomes indispensable to the repair of the vehicle - the tow truck operator has become a gatekeeper, or, Obligatory Point of Passage (OPP) in the newly forming network of actors. Without the actions of the tow truck operator, the stricken automobile (and failed sparkplug) has little chance of being repaired.

Interessement is the second stage of translation. Since the aforementioned tow truck operator has been identified as the primary actor in the immediate repair of the

automobile, it becomes necessary to convince other actors to subscribe to defined roles as outlined in the problematisation stage. For instance, the tow truck operator informs the driver that the proprietary sparkplug head used by the automobile manufacturer makes repair of a failed sparkplug impossible without the correct proprietary sparkplug wrench. Similarly, the tow truck operator also concludes that in order to repair the automobile, a trip to the local automobile repair shop is required. Therefore, the dominant actor which is the tow truck operator (or OPP) has begun to negotiate other actors' involvement, and subsequently, also their interests and *identity* in the newly forming network. The tow truck operator has dissolved the existing identity of the driver (e.g., operating the automobile in a normal fashion) and instituted a new identity for the driver: a driver requiring specialized services at a vehicle repair shop to fix his automobile. Also, unknowingly to the tow truck operator, she has also created a new identity for the failed sparkplug. The sparkplug, through her assessment, is no longer an easily fixable component of an automobile; rather, it has been given the new identity of a proprietary component that requires a specialized repair facility and tools to access.

Enrolment is the third stage of translation. With the acceptance of roles as defined by the primary actor (i.e., tow truck operator), other actors begin to solidify their identity within the newly forming network. The driver submits to the realization that his automobile will require specialized servicing from an automobile repair shop. The failed sparkplug continues to retain the new identity of a proprietary component only fixable with specialized tools, an identity accepted by both the driver and tow truck operator.

The final phase of translation is the *mobilization of allies* stage. During this stage, all actors involved reflect upon their newly identified roles in the network and reaffirm

their commitment. As the newly formed network begins to gain more acceptance, other actors silent during the previous three stages sometimes become active. For instance, upon arrival of the stricken automobile at the repair shop, the actors of the repair shop, vehicle manufacturer, sparkplug supplier, and sparkplug wrench manufactures begin to *mobilize* their support behind the action of bringing the automobile in for repair. In essence, the tow truck operator was able not only to provide the driver, the automobile, and the failed sparkplug with new identities, but she was able to access a larger network of actors to assist in fixing the vehicle. By acting as the indispensable actor in the problem, the tow truck operator was able to access the support of the repair shop, vehicle manufacturer, sparkplug supplier, and proprietary sparkplug wrenches to assist in the repair of the driver's automobile.

Healthcare-related ANT Example

The prior examination of the automobile with the failed sparkplug was provided to demonstrate the functionality of ANT to deconstruct networks into their elementary actors. Although the example has nothing to do with nurses or health technology, the elementary concepts of ANT outlined in the illustration are exactly the same when transposed to a healthcare context. Therefore, in order to solidify the use of ANT in a healthcare context, the example of the implementation of a smartphone device in a nursing clinician population will be provided to complement the previous automobile/sparkplug deconstruction. Analysis of this example will also readdress the aspects of *learning* and *conceptualizing* technology by nurses. This readdressing was done purposefully as an understanding of the ontological perspective of ANT is required in order to distinguish how these two constructs are framed by this theoretical lens.

The main actors of interest identified in this example include homecare nurses, the homecare agency's management team, and the smartphone devices. This example has been constructed in a similar manner to Lower's (2006) interpretation of ANT – the individual translation steps as described by Callon (1986) have been collapsed into one overarching *translation* heading with a subsequent description of the process. Similarly, multiple translations are shown in sequence to demonstrate the various inscription-translation processes in action. Finally, although a number of other actors could be inserted into this example, for clarity purposes only the three major actors listed previously (i.e., nurses, management team, and smartphone) will be described in detail.

Nurses, Management Team, and Smartphone Example

The management team of a homecare agency wishes to implement a smartphone device in their organization. It is proposed that this smartphone will better enable the management of the agency to track care delivery and mileage expenditures by the agency's nursing staff. Nurses in this homecare agency visit patients residing in their homes and deliver healthcare services according to the patients' health requirements. To facilitate travel between different patients, nurses in this agency use their personal automobiles to drive to patients' homes and places of residence. Time spent at each patient's house and the mileage expenditures acquired over the working day are recorded by the nurse and submitted for reimbursement using paper-based invoices, faxed to the agency's main office. The proposed addition of the smartphone to the nurses' daily workflow is scheduled to replace the current fax-based invoicing system. To do this, the global positioning system (GPS) feature of the smartphone will be used to automatically calculate the daily mileage expenditures incurred by the nurses (instead of the nurses

transcribing their odometer reading from their vehicles). Similarly, the clinical software on the smartphone will be used to track the duration of each homecare visit. The management of the homecare agency is especially excited to be able to improve their reporting of mileage and care expenditures through the implementation of this new smartphone device. Nurses at the homecare agency are suspicious of the proposed smartphone. Some nurses voice their discontent with the smartphone, calling it a work-based Orwellian tracking device. The management team of the homecare agency senses the trepidation of the nursing ranks and searches for a solution to promote the acceptance of the smartphone by the nervous staff.

> **Translation 1**: The management team searches for a solution to mandate nurses to use the smartphone in their practice for time and geographical tracking of client care delivery. To do this, the management team represents itself as an Obligatory Point of Passage (OPP) by addressing staff during the smartphone orientation session to reinforce the smartphone's importance to client care delivery and resource allocation. The clinician staff retains mixed opinions regarding the implementation of the smartphone, even after the verbal presentation provided by the agency's management representative. Therefore, at this stage, the goals of the nurses and managers are not aligned.

> **Inscription 1**: The management team attempts to inscribe verbally to the nursing staff that use of the smartphone in practice is a requirement for client care delivery. Nonetheless, the durability of this inscription is challenged (whether explicitly verbalized or not) by the nursing staff who feel the smartphone adds little value to their clinical work and nursing role.

Translation 2: Wishing to continue to reinforce the verbalized importance of the smartphone, the management representative distributes newly drafted, agency-wide policy documents outlining the new clinical processes generated by the addition of the smartphone. In these documents, a new nurse remuneration structure, tied directly to usage of the smartphone, is outlined. It is made explicit in these policy documents that financial remuneration for expenses and services provided by the nurses will not be authorized unless the smartphone's patient and mileage tracking capabilities are used. Therefore, unless nurses carry and use the smartphone as mandated to track their client care delivery and mileage expenditures, no financial remuneration will be provided to them for their services and expenses rendered.

Inscription 2: The management team begins to solidify the non-voluntary nature of the smartphone implementation in the nurses' workflows by generating new agency-wide policies nullifying the past nursing remuneration process. As a result, more nurses heed attention to the smartphone policy document as it directly influences their future remuneration.

Translation 3: As a final action to help solidify the process of client care delivery underpinned by the time/geographic tracking capabilities of the smartphone, the management representative assigns each nurse a specific smartphone device. Each smartphone's serial number is recorded and aligned with the nurse's name on a master list. At this time, nurses are taught how to use the various features of the smartphone according to the themes delivered in the aforementioned Inscription 1 and Inscription 2. At the end of the smartphone teaching session, the

nurses are informed of the start date when the new agency-wide policy becomes effective (see Inscription 2), and the clinicians will be expected to use the smartphone as prescribed in Translation 1 and 2.

Inscription 3: The smartphone is the final management-sponsored inscription in the creation of this new network. By generating verbal and policy-related inscriptions of smartphone use, the actual smartphone becomes an inscription of the wishes of the agency's management team. Therefore, although the nurses might see the smartphone as merely a piece of burdensome communication technology, the smartphone actually imparts the values, interests, and motivations of the agency's management team. The smartphone, in essence, functions as a *delegate* on behalf of the agency's management team.

The newly formed network of nurses using the smartphone in practice begins to solidify and stabilize as time progresses. The management team was able to align their goals (e.g., smartphone use in client care delivery) with an underlying goal of the nursing staff (e.g., financial remuneration) through various coercive forces. They were able to convince the nursing staff of their gatekeeper powers (i.e., OPP), and eventually, fashioned durable identities for both the nurses and the smartphones. As nurses continue to use the smartphone as prescribed, the Blackbox of smartphone use by clinicians becomes solidified and some level of stabilization of the immediate network is achieved. Therefore, the nurses' eventual use of the smartphone in their clinical work, as mandated by the agency's management, is translated into a Blackboxed network.

Although the potential durability of the nurse-smartphone usage Blackbox seems robust by the end of Translation 3, the resilience of this Blackbox can be challenged at

any time. The nurses using the smartphone might discover technical work-arounds that violate corporate usage policies or partake in the active sabotage of the device's implementation. These types of *anti-programs* fashioned by other actors to espouse their own specific goals and values can sometimes cause developing networks to become unstable and force the (re)opening of Blackboxes (Lower, 2006). Alternatively, the smartphone usage might become strengthened and further stabilized if staff find the device useful, and possibly, important in their daily nursing roles. In this case, the Blackbox of smartphone usage would begin to solidify and the collective action of the actors comprising the network would "act like a single actor from the perspective of other actors" (Lower, 2006, p. 98).

ANT Conclusion

ANT provides a perspective from which to view the evolving relationships of nurses and technology. As outlined in the previous sections, even the most subtle socio-technical scenarios are open for exploration when approached with a lens that embraces the importance of actors typically ignored throughout the research process.

One key feature of the chosen theoretical framework is that ANT does not require a researcher to decide in advance a list of actors or research areas that will be explored. As Latour (2005) outlines, "ANT is not interested only in freeing human actors from the prison of the social but in offering natural objects an occasion to escape the narrow cell given to matters of fact by the first empiricism" (p. 114). Subsequently, both human and non-human actors will have a voice in this analysis, depending on their durability and importance in tracing a network.

Researcher Positionality

The positionality of a researcher in qualitative research is an important element of the research process. Positionality is defined as "social, locational and ideological placement…[which] may be influenced by biological characteristics such as class, race and gender, as well as various formative experiences" (Kearns, 2005, p. 193). These various characteristics can influence the actors and objectives in a study, and ultimately, the research findings (Sheehan, 2011). Sheehan (2011) advocates that when researchers use ANT, they should maintain personal reflectiveness throughout the entire research process. Similarly, she reinforces that researchers must be aware that they are *part* of the larger network of actors being examined. Therefore, given this situated nature of the researcher in both the networks being uncovered and being described, it is important to be candid regarding the projection of my unique characteristics as a researcher-clinician actor that have influenced the research process. In the following paragraphs I will outline my background and embeddedness in the topic selected for study.

In 2002 I was introduced to the topic of nursing informatics and eHealth during my undergraduate nursing education. As part of a second year course, I developed a website as a learning outcome for a community health project, which reinforced my interest in using technology for educational and healthcare purposes. This subsequent interest in informatics and eHealth was a significant motivator that led me to pursue graduate education shortly after completing my undergraduate degree in 2004. Upon completing my Master's in 2007, which included examining computer-conferencing technology in nursing education (Booth, Andrusyszyn, & Iwasiw, 2011), I was afforded an opportunity to develop an educational curriculum and toolkit for practicing nurses on

the topic of eHealth for the Registered Nurses' Association of Ontario. It was from the combined experiences of my graduate education and this consulting project that I began to develop a deeper appreciation for the socio-technical underpinnings of human-technology relationships.

With the continuation of my formal education at the doctoral level in late 2007, I became further intrigued by the use of technology in healthcare, and the (at times) lack of critical reflection provided to the subject matter by other researchers and practitioners. To complement my growing knowledge of educational principles and professional practice, I sought to take courses in other disciplines to diversify my understanding of human-technology relationships. In 2008 I took two graduate courses in Information Systems which allowed me to refine my ideas related to human-technology interactions from a theoretical basis. The cumulative effect of these educational experiences, combined with other ongoing professional practice and informatics consulting opportunities, were key determinants stimulating the overall direction of this research study.

By 2011 I had become fully immersed in the topics of informatics, social media, and nursing education. Similarly, my feelings regarding technology in the profession derived from these previous experiences were significant factors influencing the development of the research questions presented in this dissertation. Therefore, although I have attempted to remain reflective and aware of my positionality in the research project, my embeddedness has obviously impacted all areas of this study.

In order to compensate for this degree of embeddedness, I maintained an emergent data collection process in this study that quickly took me from my immediate

network of connections. Equally important, I also sought to find actors with divergent views on technology, and ensure their meaning and contributions were added equally to the emergent theme development during data analysis. In following this process, new insights and realizations related to my own *Blackboxed* assumptions of nurse-technology use emerged and served to help recognize my positionality.

Methods

To conduct the study, I used an interpretive-descriptive research approach underpinned by ANT (Latour, 2005), combined with specific sampling and analysis methods drawn from Grounded Theory (Corbin & Strauss, 2008). Historically, other researchers using ANT as a theoretical lens have used a variety of qualitative methods to study sociomaterial phenomena. Participant and group interviews, document reviews, and ethnographic approaches are common in other ANT works exploring nurses' use of technology (Mullen, 2002; Obstfelder & Moen, 2006). For this study, interviews were used as the means to collect data from human actors. Document review and direct observation were also used to collect data. These latter two approaches were especially important to identify and capture the role of non-human actors that were unable to speak directly for themselves.

From a methods perspective, ANT does not prescribe a specific sampling, data collection, or data analysis method (Gad & Bruun Jensen, 2009). Therefore, I elected to use Corbin and Strauss' (2008) interpretation of selective and theoretical sampling to assist the sampling process, and the constant comparative technique to analyze the data collected in the study. ANT is considered a "living theory" (Lower, 2006, p. 96) which is constantly undergoing development by a community of proponents and users.

Subsequently, the use of identifiable research methods borrowed from other perspectives or approaches is commonplace in ANT-based research.

Finally, ANT was used as the overarching interpretative-descriptive lens for the study. All elements of the sampling, data collection, and analysis processes were influenced and informed by this ANT lens. Cordella and Shaikh (2003) state that when ANT is used in this fashion, the lens can be used to guide the larger research process:

> ANT is very similar to an approach or underpinning assumption that…dictates how, when and what we 'see' as data. When a researcher employs ANT s/he will collect data that comes to attention – and what surfaces as important data here will be guided by the 'lens' of the theory. (p. 9)

Therefore, ANT was used to both guide development of the research methods, and also to direct researcher attention toward important data to be collected and analyzed. In this way, ANT served to guide my analysis of the types of relationships formed between various actors, and how these larger networks of action were constructed.

Sampling

The selection of actors included in this study was guided by both selective sampling (Draucker, Martsolf, Ross, & Rusk, 2007) and theoretical sampling techniques (Corbin & Strauss, 2008). *Selective sampling* is defined by Draucker et al. (2007) to be the identification of "populations and settings prior to data collection" (p. 1137-8) that can serve as an initiation point from which to begin more theoretically driven sampling. Corbin and Strauss defined *theoretical sampling* to be "a method of data collection based on concepts/themes derived from data" (p. 143) that evolves as the study is conducted.

Corbin and Strauss propose that theoretical sampling assists in maximizing opportunities to uncover dimensions and identify relationships between emerging concepts. As theoretical themes begin to emerge from the selective sampling, the "[r]esearcher must decide when to shift from selective to theoretical sampling" (Thompson, 1999, p. 816). In this study, selective sampling was initially used to identify various actors and potential environments that might serve as fruitful areas for data collection. The transition to theoretical sampling was guided by Corbin and Strauss' (2008) recommendation to *follow the analytic trail* of evidence. Much like ANT's *follow the actors* mantra (Latour, 2005), Corbin and Strauss recommend selecting data sources on the basis of their ability or potential to represent important emerging theoretical concepts. A detailed description of both the selective and theoretical sampling procedures used in this research study follows.

During initial the recruitment phase in May 2011, human actors were selectively sampled in order to obtain a collection of the experiences of people using various health technologies in professional nursing practice. In order to move forward in the research process, the initial human actors sampled during the early phases of the study were either first or second degree contacts from personal professional networks. As part of this selective sampling, human actors who fit the various roles of nursing educators, clinicians, leadership, and new nursing graduates were sought to obtain their insights and perspectives on health technology. Along with their roles in the nursing profession, human actors were also selectively sought on the basis of their experiences learning to use health technology for practice purposes. Many of the initial human actors recruited had undergone formalized education with health technology, including conference attendance, workshops, and university programs. To broaden this selective sampling

approach, a chain-sampling method was also employed during the initial phases to allow human actors to identify others who may have valuable insights into the subject matter.

As more human actors were sampled (somewhere around participant 009 and 010), the selective nature of sampling necessitated a transition to theoretical sampling procedures, stimulated by the emerging theoretical themes uncovered. By the tenth human actor interview, enough data had been collected to justify a transition toward theoretical sampling procedures based on the emerging data and coding structure. Theoretical sampling procedures as outlined by Corbin and Strauss (2008) were used to guide the remainder of the sampling in this study. As stated by Corbin and Strauss, in "theoretical sampling, the researcher is not so much concerned with consistency as following up on important theoretical leads" (p. 148). Sampling at this stage began to build upon theoretical concepts that had emerged from the constant comparative analysis and coding. During this phase, a larger and broader representation of human actors was sought to complement and build on situations and themes uncovered in the research process. Iteratively, human actors were selected based on their abilities to comment on emerging theoretical constructs, and also for their locations within larger networks of actors. Many times, individual human actors acted as gatekeepers to larger networks of actors in defined environments to which I did not have immediate access (e.g., various healthcare organizations, educational organizations, or various non-human actors). Specific environments where collections of actors congregated (e.g., Urgent Care Centre) were considered for inclusion in this study based on the environment's uniqueness and potential to contribute to the growing theoretical perspectives emerging in the data analysis. As outlined by Patton (1990) theoretical sampling can include the selection of cases "rich in information because they are unusual or special in some way" (p. 169).

During this phase of the theoretical sampling, many human and non-human actors confined to specific environmental locations were considered for inclusion. Only those environments that demonstrated traceable networks of actors and were meaningful to the growing theoretical perspectives were included in the sample. For example, the larger actor-network of an Urgent Care Centre was enrolled in the study because of the uniqueness of the example, and because the process of actor translation within the environment validated themes discovered in previously collected data. Two other larger actor-network environments (i.e., Public Health Unit, and Complex-Continuing Care Unit) were also selected and included in this study as case exemplars.

Identification of Human and Non-human Actors

During the initial selective sampling phases of this study, only human actors who were legally entitled to possess the title of *nurse* (e.g., members of the College of Nurses' of Ontario, or an equivalent regulatory body) or were recent nursing graduates from baccalaureate programs were recruited. Given the selective sampling phase, a criterion-based cross-section of nurse educators, clinicians, clinician informatics leadership, and new nursing graduates were sought. As selective sampling transitioned to theoretical sampling, human actors involved in the larger networks of health technology use by nurses were also recruited through chain sampling methods. Therefore, other non-nurse human actors (e.g., Information technology support, and registration clerk) working closely with nurses were recruited during the latter theoretical sampling phases of the research study. Although these human actors were not nurses, their role and position in the larger actor-network made them important actors in the translational processes observed. Overall, 23 semi-structured interviews were conducted with human actors.

Two of these interviews were with groups of human actors (PHU1, PHU2), and one lone human actor was re-interviewed (015/015b). The background of human actors individually interviewed in this study was extremely diverse. The nurses interviewed in isolation from other human actors included: two clinician nurse specialist/educator (001, 018), two educational faculty at schools of nursing (008, 013), six clinical informatics managers or specialists (002, 003, 004, 005, 015, 022), three of whom recently arrived or retained frontline nursing positions (004, 005, 015). The sample also consisted of three new graduate nurses (006, 009, 010), and seven nurses in a variety of practice and clinical contexts (007, 011, 012, 014, 016, 017, 023) (e.g., acute care, public health, and consulting). One informatics specialist was re-interviewed individually (015/015b). The two group interviews conducted during the study were completed in order to collect information related to the specific environment in which the actors were located. One interview was conducted at a Public Health Unit with seven individuals, including public health nurses, a dietician, IT specialists, and nursing leaders (PHU1). A second interview was conducted at another Public Health Unit with three public health nurses (PHU2).

While *technology* was an ever-present actor in the study, formal recruitment (or focus on) non-human actors was not undertaken during the initial selective sampling phases of the study. As the selective sampling phase transitioned to theoretical sampling, the role of non-human actors in the larger network of actors became more apparent and observable. It was at this point that specific non-human actors and their inscriptions began to be sought for inclusion in the data collection and analysis.

Since non-human actors are unable to *speak* for themselves directly, they were located in three primary fashions: (a) I noticed the non-human actor's existence, and

judged the actor to be important in the larger network given its position in the environment and its interaction with other nearby actors; (b) other human actors outlined the non-human actor's importance in daily work-life functions; (c) through analysis, the same type or commonalities of the non-human actor was observed across disparate environments and the examples studied.

In order to collect data related to these non-human actors, a range of flexible data collection techniques was required. One technique used to capture the representation and behaviours of non-human actors operating in networks was to document their functions in research field notes and memos. Similarly, direct observation of various non-human actors in action was used in the Urgent Care Centre environment to determine how technological actors interacted with their human counterparts. Data including how the technology looked in its context, its location, and its role and its proximity to other actors in the environment were noted in field notes and memos. Other virtual non-human actors were accessed by visiting their online inscriptions (i.e., Facebook page), and capturing data related to the role and function of these non-human actors (i.e., code PHU-FB). Finally, human actors also provided a range of descriptive and qualitative interpretations of various non-human actors found in their surroundings. These insights were typically captured in the interviews conducted with human actors enrolled in this study.

Data Collection

Volunteer human actors who agreed to be interviewed for this study were interviewed face-to-face at a mutually convenient time and location. Telephone interviews were primarily used when the individual was geographically bound, or when scheduling necessitated a telephone interview. An interview guide (see Appendix B) was

used and refined as emerging theoretical concepts were discovered during data analysis. All interviews were electronically recorded on the researcher's laptop and also by a backup desktop recorder.

All the interviews were transcribed verbatim by a professional transcriptionist. To ensure the quality of the transcriptions, they were reread by the researcher while listening to the audio of the interviews to validate the tone and nuances voiced by the human actors. Any non-human actors, inscriptions of various technologies, or environmental considerations discussed were documented in field notes for further exploration.

As preliminary findings began to emerge and crystallize, a more concerted effort was made to approach specific environments (or larger actor-networks) to *follow the actors* highlighted or mentioned by a previously interviewed human actor. Access was obtained to three exemplar environments (i.e., Urgent Care Centre, Public Health Unit, and Complex-Continuing Care Unit), as facilitated by human actors who offered to negotiate permission through various key stakeholders (e.g., supervisors or managers). Data was collected from and about these environments in three fashions: (a) through various inscriptions of the environment and from the actors contained in the environment; (b) direct researcher observation of the environment; or, (c) through descriptions and reflections outlined by human actors in interviews. Inscriptions of the environment included policy documents, signs, websites, and other archival material that explained the purpose or role of the actors. Researcher field notes from direct observation also served as inscriptions of the environment.

Data Analysis

Constant Comparative Technique

Corbin and Strauss' (2008) constant comparative technique was used to analyze data from semi-structured interviews and related inscriptions. The constant comparative technique was described by Corbin and Strauss (2008) as an "analytic process of comparing different pieces of data for similarities and differences" (p. 65). Upon transcription of the human actor interviews, I began to look for initial themes by use of memoing facilitated by constant comparison of the data and open coding. Open coding is conceptualized by Corbin and Strauss (2008) as naming, organizing, and categorizing various phenomena uncovered in text. As open codes were developed from the data collected, the exploration of relationships between codes was undertaken in a larger process of axial coding. Axial coding is the process of exploring relationships between categories, and attempting to make connections between them (Corbin & Strauss, 2008). Throughout this axial coding process I began to integrate thematic categories into larger, central phenomena categories, facilitated by the reflections and ideas captured in memos generated over the data collection and analysis processes. The iterative process of re-reading the transcripts, coding, memo generation, and conceptual operationalization of ANT principles continued until data saturation began to occur. Corbin and Strauss outlined that data saturation occurs "when no new categories or relevant themes…emerg[e]" (p. 143). I began to recognize that themes were stabilizing when repetition and alignment of themes occurred between disparate environments and actor-networks enrolled in the study.

ANT Interpretation

In conjunction with the constant comparative technique, ANT was used simultaneously as the overarching conceptual lens to drive the identification and interpretation of emerging theoretical themes from the raw data. To do this, focus during the interpretation and analysis processes was directed toward exploring the *translational* aspects of actors and inscriptions involved during nurses' learning and conceptualization of technology used in practice. Themes that emerged surrounding the definition and conceptualizations of health technology were also approached from an ANT perspective (Chapter 4). Learning themes, strategies, and inscriptions were also generated in a similar fashion (Chapter 5 & 6). Questions related to past, current, and future learning about technology were examined from an ANT perspective, by seeking dominant actors that influenced the translational process of how nurses learned about health technology used in practice.

Analysis Process

The qualitative analytical software, QSR NVivo 9® was used to assist in the organization, coding, and analysis of the raw data. All transcribed interviews and other inscription data were loaded into the QSR NVivo 9® software. Initial codes were developed by using this hybrid analytic-theoretical inspired approach, and further refined over time by the addition of new data, and by an ongoing reinterpretation of the data. During this iterative analysis process, the human actors interviewed were sent various sections of their transcript with my interpretation for member-checking purposes. Member-checking is advocated by Cho and Trent (2006) when exploring thick descriptions of individuals' understandings of a given phenomenon or context. They

state that member-checking in such instances should act as "transactional assurances" (p. 329) that the researcher has appropriately captured the meaning intended by the participants. Similarly, during this time, discussions with supervisors and mentors were used to assist in redirecting perspectives and sharing advice regarding data analysis and interpretation. This assistance during the data analysis process was invaluable in terms of both refining themes and also broadening my understanding of the preliminary interpretations I had proposed.

To further assist in drawing networks between contextually disparate findings, specific environments where the non-human actors functioned were sought and further explored (i.e., Urgent Care Centre, Public Health Unit, and Complex-Continuing Care Unit). The exploration of these three larger actor-networks allowed me to physically or electronically follow the human and non-human actors throughout the translation processes in the different environments, whilst comparing the emerging findings against themes developed from the actors accessed during the earlier selective sampling phase.

Trustworthiness and Authenticity

To promote the trustworthiness and authenticity of this study and its findings, effort was undertaken to meet the qualitative rigor criteria presented by Schwandt, Lincoln, and Guba (2007): (a) credibility; (b) transferability; (c) dependability and confirmability.

Credibility

Credibility was sought in this study by remaining embedded in the data and research environment for a prolonged period of time. *Persistent observation* was utilized

in much of the data collection, especially in relation to environments where larger actor-networks needed to be deconstructed into their elementary actors. Given the complexity of these networks, time was spent interviewing/observing actors in their physical contexts in order to gain an appreciation of the larger and encompassing actor-networks in the environment. Member-checking with a cross-section of the human actor participants was also completed to ensure voices and comments were captured in an appropriate and cohesive fashion. Finally, Schwandt et al. (2007) recommend peer debriefing to reinforce creditability of the research work. Throughout the entire research process, a number of formal and informal peer debriefings were conducted with supervisors, advisors, colleagues, and experts in an effort to "keep the inquirer honest" (p. 19).

Transferability

Schwandt et al. (2007) recommend the usage of "thick descriptive data" in an effort to capture enough about the narrative's "context so that judgments about the degree of fit or similarity may be made by others who may wish to apply all or part of the findings elsewhere" (p. 19). Effort was taken to ensure context and *thick* descriptions and passages that reflect these elements were presented in the findings section in order to provide context for the reader, and also to locate and validate the positionality of the actor in their environment.

Dependability and Confirmability

Dependability and confirmability of the research findings presented in this dissertation were approached in a few different fashions. Dependability was established through the use of multiple qualitative data collection methods and the theoretically

sampled actor participants. Since information was collected from both human and non-human actors, it could be argued that a larger and more representative observation of various networks of action was captured. Confirmability was also sought through the use of memo writing, regular meetings with thesis supervisors and advisors, and an emergent audit trail of coding and data collection captured through the use of QSR NVivo 9® qualitative analysis software.

Chapter 4 - Nurses' Conceptualization of Health Technology Used in Practice

In this chapter the findings of the first research question are described and interpreted. The question addressed was: *How do nurses conceptualize health technology used in practice?* Three themes emerged from the data analysis. First, nurses generally situated themselves as the *users* of technology in their descriptions and discussions of health technology. In combination with this positioning, nurses were able to name and identify various types of technology they used during practice and in everyday life. Second, nurses used a wide array of conceptual and philosophical approaches to describe what technology was, and how it did or did not influence their lives. These conceptual perspectives offered insight into the role and agency of non-human actors in relation to the roles and lives of the nurses, and to the dynamic networks that underpin the technology's use. Finally, nurses' conception of technology commonly included the theme of how technology enabled some sort of ability to perform or generate action in their immediate work or personal lives.

Positionality and Technology Description

Nurses spoke about technology used for both work and personal purposes, and reported a wide repertoire of examples. Given the significant variety of backgrounds (and various experiences accumulated by each nurse), there did not appear to be any overt patterning in terms of the types of technology described. That said, for nurses who had remained in a specific practice area for a prolonged period of time, the breadth of descriptions and examples of technology appeared to be more fixed to their immediate

context than for nurses with a wider array of experiences across the profession. For instance, participant 013 (nursing faculty at a university) stated that she had spent the majority of her career in classroom and research settings, and subsequently based her identification of health technology on technical actors she was familiar with in this context:

> I'd have to say that I really look at technology or define technology…as a tool to … help in the teaching and learning spaces. And I think it really hasn't changed for me as a tool. (013)

Similarly, participant 007 who had spent the last 35 years working in intensive care environments provided examples of acute care-based health technology drawn from experiences:

> Clinical [health technology], is Citrix.… Oh, there's all kinds of equipment. There are infusion pumps. There may be telemetry packs, there are special dressings called back dressing, anything that has, directions or you have to hit a control, powered by electricity or – those are just a few things that have come up…Epidural, PCA pumps, those kind of things. Well, technology's pretty much…the computers, the electronic documentation - that's what I think of as technology. But, again, these machines, these devices that we have – powered by battery or powered by electricity, Alaris pumps or epidural PCA – so you have to have some formal training to operate them. (007)

Conversely, new graduate nurses or other nurses who had diversified user experiences offered descriptions of health technology that were generally broader and that encompassed a wider range of technical actors across a variety of practice contexts.

For example, a recent graduate nurse who worked in both public health and acute care settings outlined the various health technologies she used to deliver care in both clinical areas:

> [Within public health,] definitely my phone, the RNAO app... We use Facebook quite a bit here… Facebook is a big part of the work that we do here especially with the prenatal stuff…. [Within acute care,] health technology, in the hospitals we have different computer-based documentations. I mean, that's a form of health technology as well for me… So the way that they document and the whole software is very different [than public health]. (012)

Although far from absolute, it would appear that nurses who had acquired experiences in a variety of practice areas tended to provide more diverse descriptions of technology actors used in their work. Nurses who had been contextually isolated in a specific area for prolonged periods of time generally only identified technologies that were used for their immediate practice environment.

Technology identification. Identification and discussion of various health information systems, clinical technologies, or communication platforms used in healthcare or education settings was explored by all human participants in this study. Common examples included electronic medical records, communication and file-sharing platforms, laboratory information systems, biological monitoring devices, a range of infusion pumps, and mobile devices. For the examples, each nurse provided a slightly different descriptor of the technology, and variations in names for the same technology were common (e.g., electronic medical record or, electronic patient record). A further permutation among the naming of certain health technologies was to call the system in

question by the manufacturer's name (e.g., Meditech, and PowerChart), rather than by a more generic neologism (e.g., electronic medical record). Mobile devices that were found in both the consumer and health sectors like iPhones, BlackBerry smartphones, and iPads were consistently described and introduced using the manufacture's brand name rather than a generic identifier (e.g., smartphone or tablet). Conversely, the preference toward identifying certain technologies through the use of the manufacturer's name was less consistent when participants described biological monitoring devices (e.g., vital sign monitors, and glucometer), input devices (e.g., computer terminals), and specific types of mobile devices (e.g., computer-on-wheels). Different types of infusion pumps were also generically referred to as *pumps*, and classification of the pump type was only provided when describing the role of the technology in use (e.g., intravenous, epidural, or patient controlled analgesic). Like the clinically based technologies described above, some of the communication platforms used in the nursing education sector also possessed dual names to describe the same platform. Learning management systems at specific universities were typically identified by the vendor's name (e.g., WebCT, and Blackboard) instead of a generic title (e.g., learning management system, or computer-conferencing). Although the term *learning management system* did arise, it was only used by 013 who was a nurse educator in a university setting.

Other technologies described by the education sector included the use of email, laptops, smartphones, high fidelity simulation mannequins, and various Internet-related technologies. The main use of most of these platforms was to support information exchange related to course requirements. In conjunction with the university or course authorized communication platforms (e.g., school-provided email account), a number of

informal information distribution technologies were also described. The use of Facebook, Twitter, YouTube, text messaging, and other social networks were commonly mentioned by new nurses and those who had recently graduated (e.g., participants 006, 009, 010, 012). For example, participant 006 outlined his use of Facebook as an adjunct communication strategy alongside the mandated nature of the university's learning management system (i.e., WebCT):

> [Facebook is] most of the time…it's personal but sometimes you do have your academic kind of creep on it. For example, I'll read up on someone's Facebook status that marks are up or where do you want to meet up… usually if there's a WebCT discussion board or email it's just easier to do that 'cause your group's already premade there. But if there's something that's class-wide – someone will update their [Facebook] status about something school related. And then you'll kind of key onto…that and maybe answer them [on Facebook]. (006)

The use of mobile and social technology both in and out of the traditional nurse role was explored and described by virtually all nurses in this study. Mobile technology including iPhones, iPads, BlackBerry smartphones, and laptops were popular with nurses, for both personal and professional roles. Social technologies like Facebook, Twitter, LinkedIn, YouTube, blogs, and Instagram were also outlined as technologies that were used by a number of nurses, for various purposes. The use of both mobile and social technologies appeared to, at times, blur nurses' professional and personal lives. For example, mobile devices like the iPhone or iPad were used for clinical purposes, but also for personal activities. A further discussion of this personal-professional blur is highlighted later in this chapter.

Conceptual and Philosophical Perspectives

As presented in the previous section, nurses were able to identify different technological actors, and also to comment on the specific environment(s) where these non-human actors operated. In order to deepen the understanding of nurses' conceptions, participants were requested to describe what they would define *health technology* to be and how they would describe the features or functionalities of health technology.

One participant, a clinical nurse specialist (001), reflected on the word *technology* and its various meanings to justify her response:

> I don't like to use the word "electronic" or anything like that because technology could even be in itself a skill or a set of skills. Because you're required to have skills to even work with, what we would call is technology, like an item. So I think it's more – it's bigger than just…an object. It's much more than that. (001)

As outlined by participant 001, *technology* could be conceptualized as more than merely computerized devices, and even used a skill or set of skills as a descriptor of technology. Another nurse (informatics analyst) also used a philosophical approach to respond to the question of defining health technology used in practice, but focused on the technical actor's features to elicit what constituted *technology*:

> So that can be a philosophy question in itself. Because technology can be defined as a stove or a chair or, I guess it doesn't have to be electronic for it to be technology. But in my mind and usually what comes to my mind right away is that something that's manual is not technology. It has to be something that relates to automation or something you have to turn on. (005)

According to participant 005's conception, in order to be deemed health technology, the technical actor necessitated the ability to be turned on (i.e., uses a power source) and be a non-manual device. The notion of *manual* devices and the need for a technology to be *electronic* was further described by participant 005 in the following reflection:

> Anything that is not manual that would [be health technology]…that assists in a clinical setting. So if a website assists in a clinical practice, I would consider that to be part of technology. If I happen to have an electronic stethoscope I would consider that technology as well. Glucometers, to me, are part of health technology…. But I guess it relates more to how they don't have to do something manually. There's an aspect of it that skips some of that manual process. (005)

Participant 005 further reinforced her conceptions related to *technology* being an actor that is not manually operated by presenting the example of an electronic stethoscope. Since stethoscopes exist in manual forms (e.g., a non-digitally enhanced stethoscope), participant 005 specifically denoted that she only considered electronic stethoscopes to be a form of health technology due to this actor's ability to "skip some of [the] manual process."

The evolving nature of nurse-technology relationships was also highlighted in some of the participants' conceptualizations of health technology. Alongside descriptions of human actors, other non-human actors not traditionally thought of as health technology (e.g., Facebook, and LinkedIn) were described as potentially being important to the healthcare realm. A new graduate nurse (010) outlined her ideas regarding emerging technology and its role in health(care):

> So [most] people thought [of] health technology [as] the system that you use at

> the hospital or clinical setting to document. And I think that's somewhat true. But I think health technology could also be used in terms of social media technologies, because there are things – like, LinkedIn, Facebook, et cetera, [that can be used] for health purposes. (010)

Many times, participants stated that their understanding or conceptions about technology had evolved over time, and that they had broadened their perspectives of what health technology entails. Three participants presented salient reflections outlining their evolving conceptions of technology used for health purposes. Another new graduate (006) stated, "I think health technology would be anything that…you can apply either in the online or physical space that has its intent to promote health". This participant's conceptualization of health technology reinforced the concept that the health technology actor can exist outside of traditional healthcare spaces (e.g., hospital), a theme further expanded by participant 002. Participant 002, a clinical informatics manager nurse outlined that health technology was to promote and support individuals' health, and functioned beyond the walls of hospitals:

> health technology includes both mechanical, software, application of mechanical and software advances to provide care that is focused at people's health...and so, that's how I would say it....and it goes beyond hospitals into the community. (002)

Although participants 002 and 006 broached an expanded conceptualization of health technology and its situated nature, participant 004 (telehealth specialist nurse) was the most explicit in terms of verbalizing what she believed to be the essence of health technology. Firstly, participant 004 outlined that there was "no difference" between technologies used in physical settings versus online spaces. Secondly, she claimed that

health technology exists at the time, place, and location of where it is needed, and for the purposes of "what the person wants":

> [Health technology] allows you to communicate with a healthcare provider or the healthcare field. It allows you to get information about your health or how you want to manage it. There is no difference [between health technologies in physical versus online spaces]. But if you think about health technology, in terms of how it supports the person and how the person wants to use it…that's how I think about it. And it's more patient-centred that way, because it's centred around what the patient wants – what the person wants. (004)

It would appear that the appreciation of what health technology is, and where it exists, is a dynamic and multidimensional construct. As outlined above, nurses conceptualized health technology as actors that were electronically-based and eliminated some element of manual functionality. Health technology was a broader construct than other technological actors in traditional healthcare spaces like hospitals. Health technology was a technological actor (or network of technical actors) that could exist in both the physical and virtual worlds to serve the promotion and delivery of health(care).

Network influence on conceptual perspectives. How nurses conceptualized health technology also appears to be informed by their embeddedness in larger actor-networks of practice. For instance, some nurses were quick to justify their conceptualizations of health technology by using other proximal actors in their networks as evidence or as a rationale for their comments. Privacy policy, provincial regulation, and expense were commonly mentioned actors of importance, modifying the individual nurse's conceptualization of health technology:

> Health technology is generally more expensive…because it's caring for infants, some of things that would normally be 'technology' have to be certified by different agencies - but it goes through such a rigorous certification for safety, that something else wouldn't have to. (002)

Insight into the role other actors have in respect to shaping health technology used by nurses appears to be a significant element of how nurses operationalize their use of technology for different purposes. Given the importance and strength of many actors' influence (e.g., regulatory bodies), some participants were hesitant to enact their interpretations of health technology for fear of repercussions. For instance, a new nurse (009) outlined her trepidation to label social media platforms like Twitter and Facebook as potential examples of health technology:

> I do see a differentiation because, healthcare is very, very strict with very structured frameworks and, you know, confidentiality things…. So I think that what is used in a hospital is very serious and very specific to using it in the hospital, like Meditech for example. But when it comes to Twitter and Facebook and things like that, I don't think people necessarily view that as medical related or healthcare related. It's more of a public domain which you can use for health. But I think because people still view it as unprofessional, when hospitals are very professional institutions. The line isn't quite blurred *yet*. Personally, I think it should be, but because of confidentiality and privacy and, you know, that whole thing. I don't think we're quite there. (009)

Although it would appear that the concept of health technology has broadened over time, the actual ability to exercise many of these conceptualizations in practice may be impeded by other powerful, peripheral regulatory actors. For instance, participant 004 recalled the moment when she realized her conception of health technology differed widely from the espoused view of faculty during her undergraduate education:

> I got *so* frustrated in my undergrad because the view of technology was not how I viewed technology at all. And it was just like no, I've got to do something about this way of thinking – that technology is a *barrier* to patients.... And so that kind of language with a nursing curriculum really irks me. (004)

Due to participant 004's position as a student, she was not able to formally challenge the faculty's conceptualizations of health technology during her undergraduate education. Participant 004 eventually waited until after graduation to seek employment in an environment (i.e., telehealth nursing role) that would be more receptive and allow her to enact her conceptions of health technology.

Impediments faced by participants to influence or translate rigid conceptions of health technology were also uncovered by nurses working in a Public Health Unit. Nurses working at this Public Health Unit had proposed the use of Facebook and other social media platforms as part of a larger health promotion program to clients in their geographic region. Early in the implementation of the program, a number of senior leaders at the Public Health Unit were skeptical about the use of social technologies to distribute health related messages. Other staff not involved in the implementation also voiced their concern that nurses were wasting time "fooling around" (017) on Facebook

and watching YouTube clips. A public health nurse (017) involved in the Facebook project stated:

> We were using it [Facebook] for a health delivery message so when I was interviewing some of the staff involved throughout the project, just sort of one-on-one interviews. And some of the comments that came up around, you know, sometimes we feel like people think that we're fooling around on a [Facebook] page, that we're not actually doing work because it's Facebook, right. So it was just around delivering health messages, but if they're walking by your desk and they see [you on Facebook] …. [It seems they're thinking:] "They're not doing their work. You should be on the phone." (017)

The importance of other actors in the stimulation and enactment of nurses' conception of technology appears to be a complex and dynamic relationship. Subsequently, it is unclear if nurses who espouse different conceptions of technology from the norms reinforced in their environment are able to exercise these conceptions in practice. Therefore, although health technology may be broadly viewed as more than technological actors confined to healthcare settings, the actual enactment of these opinions appears sometimes difficult to implement in reality.

Conceptual blackboxes. As demonstrated in the preceding section, there are many social and material actors that appear to influence how nurses conceptualize health technology used in practice. For instance, in response to the question of defining health technology, a few nurses openly admitted that they had difficulty responding or voiced hesitation in their response (e.g., "Yeah, I'm struggling with this one" [013]; "Let me think on that for one sec. I don't know. I think – I honestly don't know how to answer

the question" [010]). It would appear that generating a definition required individuals to deconstruct robust (and typically) stabilized networks that had formed around the use of health technology. Although all interviewed nurses were able to provide some level of definition of health technology, the difficulty experienced by some in generating a definition may speak to a larger force obscuring the visibility of technology in the healthcare space.

For instance, participant 005 claimed that she did not become aware of health technology until completing an advanced clinical placement in a stem cell apheresis clinic. It was only through the experiences obtained during her placement and a growing interest in nursing informatics did participant 005 begin to realize what health technology was, and how it was being used in the clinical environment:

> I didn't come to a realization that I was using health technology until my stem cell apheresis clinic practicum. Only because I started to become more interested in health informatics or nursing informatics specifically. And so everything that I used that was technology became – it was a realization for – to me that this is all health technology. Because a lot of nurses I encountered [didn't] know how to use the computer. I'm not good at this technology stuff. And then I would tell them, well, you're an ICU nurse, you actually use technology all the time. (005)

As outlined by participant 005, the visibility of the technology was clouded by various other actors, and the presence of health technology did not emerge until interest in the subject matter (i.e., nursing informatics) was actively pursued.

Participant 015 experienced a similar, yet different reaction in regards to both becoming aware and cognizant of health technology in practice. Previous to moving into

a nursing informatics role, participant 015 claimed to be "anti-technology" and questioned its relevance within her role as an intensive care nurse:

> I can't imagine not having it [technology] *[laughs]*. That's pretty funny. Yeah, I can't imagine not being able to access things using technology. In fact I look for technological solutions now versus balking [at] it. The I.D. monitors down in the unit, I want to see them interface the volumes and fluid volumes into the EMR, versus balking [at] it. [It has become]…visible and valuable. (015)

Participant 015 was only able to realize the value of certain health technologies after she was able deconstruct the Blackbox network that had been generated around her use of health technology for nursing practice. Her previously fashioned Blackbox of nurse-technology use did not allow for the conceptualization of health technology as a positive or visible feature; rather, participant 015's opinions had been developed in opposition to the use of technology for clinical practice. Only after immersion in the role of nursing informatics, which necessitated the questioning of her immediate Blackbox of nurse-technology use, was participant 015 able to reconceptualize her understanding of and relationship with health technology.

Action-Praxis

Nurses' conceptualizations of health technology was typically verbalized in terms of the action or praxis that was carried out using the technology in question. The emphasis on use-value led to the development of an *action-praxis* theme that contained two subthemes related to technology conceptualization: (a) *Achieving a goal or outcome*; (b) *Changes in the nursing role*.

Achieving a goal or outcome. Along with the philosophic interpretations tabled by nurses, many of the conceptualizations provided by participants were grounded in the idea that human and technological efforts could be used synergistically to generate action in practice. When asked about the types of technology they used in both practice and personal environments, almost every participant provided a summary of technical actors important in their lives, and a description of their use. It seemed that participants felt obliged to expand on the technology they used by demonstrating, and at times justifying its functionality or usage in practice. This trend was probably best exemplified by participant 011 describing her use of an iPhone, which was an important actor in her technological repertoire for both personal and work purposes:

> I have a GPS in my car, but I primarily use my iPhone for directions to places. I do read the news on there. I have my apps that have the news. I have got into watching video on there, but, yeah, I use it all the time. I have a really large data plan, so even if I'm using, I don't worry about how much I use it. I just use it all the time. (011)

Like the iPhone example above, participants generally conceptualized technology used in praxis to be an assistant or something that facilitated a cascade of further actions. The majority of the technologies mentioned by individuals were described in ways that highlighted how a nurse could work with a technology to achieve a goal or outcome. This dynamic nurse-technology relationship was illustrated by participants through their use of descriptive action verbs and words that connected human and technical actors. For instance, participants spoke about using technology to *communicate* information related to patients and their care:

> I think anything can be used as health technology as long as it promotes communication…the main challenge is the communication amongst all the different parties. So anything that promotes that communication and stores health information is useful. It [health technology] allows you to communicate with a healthcare provider or the healthcare field. It allows you to get information about your health or how you want to manage it. It allows you to seek out advice. (004)

The notion of communication was also extended by participant 003 who outlined how health technology not only assisted in communicating information, but also enabled visualization of information to facilitate the knowledge requirements of clinicians:

> I think there's lots of technology out there that has relevance for healthcare, it's about communication, it's about visualization, it's about being able to research and have information at your fingertips…. They're going to be able to communicate with it, they're going to be able to, you know, to research and stuff like that. Some of the [technology] that underpins…some of the databases that are being fed with information, it only becomes meaningful if it's a tool that they [clinicians] can use. (003)

In line with participant 003's perspective that health technology could assist in providing information at a clinician's "fingertips", participant 011 described that both the health technology and information conveyed should be organized in order to facilitate ease of use by the end users. This notion of *organization* is presented below:

> There's some capability within it that it can support someone who's addressing a health issue or that it has, the ability to organize information in a way that's relevant to health…. That it's convenient and, you know, easy to use in that

manner. (011)

The idea of organization to facilitate ease of use was also alluded to in participant 005's through her discussion of health technology as an actor that *assisted* clinicians in their work:

> [Health technologies are]…devices that assist staff members or individuals in a clinical setting, that assist in a way that could potentially automate some of their work, or maybe *automates* not the right word. So in terms of the blood pressure cuff example, manually you have to use your stethoscope, listen to the pressure – get the reading. But when you're using an electronic one, you just put the cuff around the arm and *there it goes*. (005)

It would appear that nurses' conceptions of health technology commonly endorsed some element of action or praxis in a health environment. This action or praxis ideation was typically a means to generating an outcome or product from the interaction of humans and technology. Technology was not viewed as static or characterless; rather, it was seen as a dynamic actor in the larger sociomaterial network of human (e.g., clinicians, patients, "different parties" [004], etc.) and non-human actors contributing to health(care).

Changes in the nursing role. Nurses outlined how their use of technology provided a medium with which to deliver or foster care for patients and consumers. Although many of the human actors typically elected to describe technology that they deemed indispensable or important to their practice, some nurses took the opportunity to voice their misgivings about the factors that stimulate or perpetuate the use of poorly developed or implemented health technology. A few participants explicitly outlined how

the potential of certain health technologies were corrupted or lost due to the failure to appreciate various actors in the surrounding context. For example, participant 015 outlined her experience of watching the failure of various hospital information systems due to a lack of attention toward the needs of end-users:

> So in order for technology to be useful to a clinical care provider in healthcare, it has to be instinctive and helpful. It can't add steps to your workflow because then it does nothing to streamline your workflow…it doesn't do anything to help you. … I think if a piece of technology is put on a unit as a nice-to-have, that hasn't been well thought out or well implemented, it will be the thing in the corner that's dusty…. They won't use it. (015)

As outlined by participant 015, technology and its potential can be corrupted by numerous other actors (both social and technical) to the point where it becomes burdensome to nurses in terms of their daily work functions. The burdensome nature that a poorly developed or implemented system generates does not seem to disappear with lack of use; rather, the legacy of a poor system appears to persist in the consciousness of some nurses, and experiences with ineffective technology can at times shape their future conceptions of technology. Therefore, it is important to note that nurses do not always conceptualize technology as a positive feature. An intensive care nurse (007) with 35 years of experience vividly recounted her past experiences using a clinical record system in her practice, and her current struggles to implement the system into her workflow:

> Kind of a shame that you have to deal with such a system that's very rigid and doesn't allow – you have to go through this long way to get it all done when you could save yourself tons of time.… Computers do add to your workload and it

> certainly doesn't make your job any easier, that's for sure. (007)

Unlike many of the positive effects facilitated by technology in terms of promoting or assisting patient care, the action generated by nurses using technology was not always positive. One interesting byproduct of the nurse-technology relationship was the blurring of personal and professional lives. This blurring was acutely captured by two nurses who described how their professional roles crept insidiously into personal time when they were not being remunerated for their nursing role. Participant 007 described how a computer terminal that was installed in her unit's lunchroom started to be used by clinicians during their lunch and other break periods to catch up on patient documentation and charting:

> You've got an option to do that [documentation and charting during break periods]…that's really not what it…your break [should be used for] – [you] should be entitled to do your own stuff [during breaks] but oftentimes we find ourselves charting…in our lunchroom…. And you're on your time off doing your charting (007)

As participant 007 discovered, the ease of access to technology had an insidious tendency to creep into personal time not intended for work or clinical functions (e.g., break time). An informatics nurse manager (003) also discovered that access to a mobile device containing work related email and scheduling also allowed work to creep into her personal time:

> Do I peek at it [work BlackBerry] at night, do you mean? Yeah, I do. I have a lot of different routines for my evening and stuff, like, I take my dogs out for walks and, household stuff that has to get done. And I'll usually pop onto Facebook to

> see, how some of my friends are and stuff like that. If I'm doing something sort of mindless, like, watching a TV show or something, I'll pop out the [work] BlackBerry. Yeah, see what's on – you know. What have I got on tomorrow? Oh, yeah, right. *Wear the suit*. (003)

Interestingly, although many of the participants outlined both positive and negative relationships with various types of technology, none of the participants voiced ideas that positioned technology as a classical deterministic actor; rather, participants seemed aware that technology needed to function in conjunction with nurses, and not separately. In addition, participants seemed cognizant of influential social elements that drive their conceptions of technology (e.g., regulatory factors, or resources), but were also aware of the power of technological actors in the overall relationship. The majority of nurses understood that technology used in practice was influenced by social factors (e.g., opinions of other nurses), but also highly dependent on the flexibility and functionality of the material actors (e.g., how Facebook's usage for health purposes was dynamic and dependent on context). None of the nurse or other human actors interviewed in this study provided reflections as literal as *technological optimism* or *technological romanticism* perspectives would suggest (Sandelowski, 1997a). Participants refuted any notion of *technological romanticism*, in the way that technology could replace the nursing role or require limiting the use of technology to ensure the essence of nursing was upheld. Some o*ptimist* ideals did permeate a few of the participant's discussions (e.g., participant 011), in the way that prized technological actors were carried at all times by human actors, or harmoniously co-existed alongside the nurse in day-to-day functions (e.g., iPhone). Regardless, like the notions of

technological romanticism, none of the *optimist* views provided by nurses were as literal as originally presented by Sandelowski (1997a), for example, the "symbiosis of nurse and machine" (p. 170).

Summary

As demonstrated in the preceding sections, there are many social and material actors that influence how nurses conceptualize health technology used in practice. Some of the key actors that were traceable through participants' narratives included: the movement and operation of various technical systems like social media and healthcare information systems; various inscriptions of privacy and other regulatory mandates; the nursing profession, its ideals, and the ingrained culture to deliver care to clients/consumers; and, aspects surrounding the environmental context in which each participant was situated (i.e., personal and professional). Similarly, this section also highlighted potential Blackbox networks that perpetuate fixed conceptions of health technology by nurses in practice. For instance, a number of participants sought to include social media technologies not traditionally found in healthcare settings into their descriptions of *what is health technology*. Participants that voiced this perspective consistently felt obligated to justify such an inclusion, and were less eager to enact their broader conceptions of technology in their practice. Traditional health technology like pumps, electronic medical records, and other biological monitoring devices were generally accepted and described by participants in this study without any qualification of their value or nature as *health technology*. This interesting duality of perspectives speaks to the power of other actors (e.g., other nurses or policy artifacts) in the nurses' environments and in structures that continue to reinforce *what is health technology* and

where/when it is allowed to exist. While some nurses voiced extremely broad interpretations of health technology, in reality, their conceptions of technology in practice seem to be buffered by the strength of other powerful actors in the larger network.

In the following two chapters, findings related to how nurses learn about health technology will be presented. Through the presentation of these findings, detailed deconstructions of various actor-networks that underpin human-technology interaction will be conducted. Through these larger deconstructions of networks, how nurses operationalize their conceptions of health technology will be elucidated by exploring the process and products of nurses' learning of technology used in practice.

Chapter 5 – How Nurses' Learn about Health Technology Used in Practice

Like the conceptualizations of technology described by nurses in Chapter 4, the *learning* about technology by nurses was also found to be varied and multidimensional. Learning was described by nurses as both a process in the uptake of technology and as a by-product of the translational process of actors coming together and developing new programs of action. Therefore, the first half of this chapter will explore learning about technology as a *process* actualized by nurses, as well as a *product* translated in larger actor-networks where nurses exist. In the latter section of this chapter the aforementioned *process* and *product* perspectives are collapsed in order to describe three strategies that influence learning of technology by nurses.

Learning as a Process and Product

Learning as a Process

Nurses learned technology through a wide variety of methods and actions. A common theme throughout the experiences of nurses in this study was that the process of learning about technology occurred primarily via informal means. Marsick and Watkins (2001) described *informal learning* as something intentional, but lacking structure (e.g., asking assistance from others). From the data analysis, it was found that informal modes were generally preferred by nurses to *formalized learning* opportunities (e.g., structured continuing education or orientation sessions for technology). For instance, participant 015 described her learning about technology in her current role as both an intensive care nurse and clinical informatics analyst:

How I learn about technology? I think we learn about it as a part of our jobs.

> We…don't go to anything formalized education to learn about next levels of technology or what's coming…. We do stay very connected with Meditech as our software provider, with their updates.... I did a market scan and was involved in the RFP [Request for Proposal]…for devices,…cardiac monitors, et cetera. So you just – in my role, I just learn about it…the technologies as I go. (015)

In participant 015's case, learning about and how to use technology had become an organic process in her dual roles as an intensive care nurse and informatics analyst, which also engaged a number of actors in her proximal networks. For instance, along with learning the technology required for her roles (e.g., health information systems in her organization), participant 015 also extended her learning in a more abstract fashion by studying inscriptions of other related technological actors. She outlined that she continued to remain abreast of new health technology solutions by maintaining connections with the primary vendor of the organization, Meditech, and regularly reviewed the system documentation they provided. She would also complete various market scans for new health technologies and generate requests for proposals (RFPs) for the procurement of new systems to complement the organization's current repertoire of health information systems.

This largely informal approach to learning technology was also demonstrated by participant 001 in her description of learning an electronic medical record (EMR) system as a clinical nurse specialist. Participant 001 stated that she would regularly "dive in" to learn technology with or without the assistance of others:

> Dive in there. Sink or swim. And I often swim. But I have sunk a few times and then I get help…. PowerChart [an EMR] is another example…. You know, you

> finally get going, you understand where everything is, and then they [the Information Technology department] change it [PowerChart] on you. (001)

Although participant 001 claimed to "swim" on a regular basis in terms of learning and using technology, she did seek support and assistance from others when her learning was impeded or she found herself "sunk".

Upon further reflection, participant 001 stated that she had taken a previous medical informatics course during her undergraduate education, but reinforced that most of her learning about technology for both personal and professional purposes was obtained through informal processes:

> I had a coach for social media and he had nothing to do with nursing. He walked me through stuff and I would ask a lot of questions or I'd say, really informally, you know: "I really want to learn this. Can you go over this with me?" Or, "teach me something new", and he would; so it would be very spontaneous but still very structured and I had a very close relationship…with this individual that I can – I can just ask and get help. (001)

The relationship between participant 001 and her friend who offered "spontaneous [yet] structured" teachings of technology appears to be another common theme throughout the narratives. The proximity to an individual(s) who could offer support and advice related to technology through a *just-in-time* nature was appreciated and reported as a supportive feature in learning technology. Building upon the spontaneous nature of learning as described by participant 001 (i.e., having a "coach" to assist her learning), participant 012's training on an EMR platform also utilized a similar informal instructional nature:

> we had to learn on-the-fly unfortunately. There was somebody who sat down with me for about two hours just to show me how to get from one section to another, that sort of thing…they were doing the documentation and I was watching them. But it didn't make a difference *until I had to do it* and then I had an issue, I'm like oh*, how do you get from here*? And then they would show me. So actually doing it was more helpful in having someone by my side rather than just watching someone do it... You really have to physically have to put in vital signs or have to document a mental status exam to be able to understand how to actually do it properly. (012)

Even though participant 012 was expected to learn the EMR system largely "learn on-the-fly" in her acute care role, her informal two-hour customized EMR learning experience was positively received due to the flexibility of the session to provide immediate feedback from a supportive teacher.

Unlike participant 012's positive learning experiences, two other recently graduated nurses (009, 010) experienced less than ideal orientations to an EMR platform. Participant 009 described her experience learning an EMR system and other health surveillance technologies as part of her student role in an infection control department:

> I had a placement with administration at a local hospital so I was working with infection control [department]. And it's really behind the scenes, I honestly didn't have any patient contact whatsoever. So in terms of technology I had to use – they used Meditech, but I had to do patient tracking and track infection rates and just a whole plethora of programs I'd never heard of before. So I kind of had to figure it [Meditech and other programs] out on my own so…I was asking

> questions all day long [to staff in the unit]. I had them sit down with me and go over some of the programs because there was so much work in infection control department that it was, like, *sink or swim*. They had so much work to get done that they couldn't necessarily teach me. So I had to teach myself which I guess I'm pretty decent at using technology and okay at computers. So I figured it out. (009)

Similar to participant 001, participant 009 was confronted with a "sink or swim" approach to learning technology. When questioned if she had ever received a formalized education session related to the hospital systems, participant 009 outlined that she had received a generic Meditech training session during her undergraduate education that she found to be "useless":

> Meditech [and] Horizon those are really the only things [EMR systems] that they teach you in school. I think we went to two in-services for an hour through the library on them. *Useless*, I think…. Personally, I never took anything...away from it other than: "going to the hospital and teaching it [to] myself." I mean, I'm sure some people learned from them [Meditech and Horizon educational sessions] and found them valuable, don't get me wrong. But, you know, you sit in the library [and] they teach 30 students at once what to click on next and you're following on a paper. And it's not realistic because it's not how you would ever use it [in practice]. (009)

Another recently graduated nurse (010) who experienced a similar education session of the Meditech platform also commented on how the formalized training of the platform was less than conducive to her learning the system:

> I remember the sessions to be very boring, and I think that was another thing too for somebody who was just kind of beginning to open up to technology. I think that they made it so basic that it kind of took any…energy it had out of you. And especially because towards the end, they're like: "Oh, you can play around a little bit." But because you're already told word for word of how to use it, it kind of just made it a little boring…. It's just the presentation of it too. Meditech was black and white, and [Learning Management System] and Horizon was-- there was colour. There was some life to it, you know? (010)

Participant 010 found the formalized training session to be "boring" which drained her emotional energy and interest. Similarly, the basic black and white graphical interface of the platform (i.e., Meditech) also contributed to her assessment that the session was less than inspiring. Therefore, from participant 009 and 010's experiences, it appeared that the formalized training sessions related to EMR education were not found to be overly valuable. However, even though participants 009 and 010 were critical of the formalized training sessions, their passages did note that others *may* have found the sessions useful. For instance, participant 011 was able to provide insight about the potential value of formalized, large group training sessions based on her experiences attending scholarly database (e.g., CINAHL, OVID) education sessions:

> I've been to enough of the sort of literature searching ones that I find they're often quite redundant. And depending on the group, you can be moving at the pace of the slowest person in the group…especially I find different age ranges and their ability to, that they've used that before or not, then you're moving at the pace of that slowest person and I find that I'm ready to move on and we're still stuck on

> something that I find simple. So that can be varied…. So, yeah, they're of varying utility, I think, when you're first learning brand new technology, then they're very useful. (011)

Although participant 011 outlined her appreciation of the value of formalized sessions (i.e., when first learning brand new technology), she also qualified her statements by stating that the pace of large group training typically regressed toward the abilities of the "slowest person". She also concluded that once some level of competency had been developed, formalized sessions may become "redundant" and that she would rather be provided with one-on-one sessions or other educational methods (e.g., webinar or video) to advance learning:

> The one-on-one session was obviously very useful because it simply just answered my questions. *[Laughs]* And we could move at my pace…. For the [educational] updates and the we have this new [technological] feature, I prefer to just read about it or be given a quick video I can watch online or a webinar or something like that about it. Rather than have to go to a formal session. (011)

Overall, it would appear that nurses who described their experiences learning technology used in practice generally appreciated formalized education methods (e.g., technology training session). Nonetheless, depending on the subject matter, instructor delivery methods, and other participants in the training session, these sorts of formalized learning opportunities were sometimes only marginally helpful in the process of learning a technology. Many times, participants outlined their preference (either by choice or necessity) for informal methods of learning a specific technology.

An example of the rapid evolution of formalized learning to informal methods was observed during the implementation of an electronic tracking board in an Urgent Care Centre. Prior to the implementation of the electronic tracking board, mandatory learning sessions were arranged for the Urgent Care Centre's nursing staff to review the tracking board and become proficient with its functionalities. After the go-live of the tracking board, formalized training sessions related to the technology were dissolved, and an informal approach was utilized for new staff, facilitated by the unit's nurse educator (018):

> we did more intensive sessions at that [prior to the go-live] time. So people came in and they learned and this was before the system came up. It was mandatory learning, they had to come in…. And because everyone was coming up all on the same day, we had more support people there to help them walk through things. Whereas now, the new person, they spend time with me, they learn the system, and I say to them within about two hours of you learning this system…you're going to have no problem because you'll use this system probably 10 to 15 times in that one to two hours. You'll be moving patients around [on the electronic tracking board], you'll be clicking on things [on the screen]. So the learning curve is very small and it's also [that] everyone else [clinicians and staff] is on the system, so if you had a question you could ask. (018)

In participant 018's reflection, the transition from formalized to informal learning methods of the electronic tracking board was highlighted. Participant 018 outlined that she continued to offer and facilitate informal training sessions of the tracking board for

new clinicians, but also relied on informal learning (provided by other clinicians and staff from the environment) to support and sustain the learning process over time.

Learning as a Product

The examples described in the previous section typified various informal and formal modalities of learning, which were commonly described by nurses learning to use health technology in practice. The quick immersion and "sink or swim" (001, 009) nature of these informal methods tended to focus on the process of how the learning occurred, rather than *what* was actually learned about the technology (i.e., the product of learning). In the following section, more complex elements of learning technology are explored. The focus is primarily on the products of learning, and how these products were represented by nurses.

For a nurse to obtain familiarity or comfort with technology, some combination of previously experienced formal and informal learning opportunities were generally required. For instance, a nurse (017) at a Public Health Unit described her and other people's previous competency and comfort with Facebook for personal purposes, prior to the repurposing of the platform as a web-based health promotion tool for their region:

> Let's say prior to this [public health nurse] role I'd never used Facebook to talk about work or anything to do with nursing. It was more about keeping in touch with my friends or looking at people's pictures. So it was more purely for the social aspect. While I knew how to use Facebook and what the functions were, I'd never had a group page before. So I learned how to actually start up a group page, [and] how to use a group page…then all of us had a bit of a learning curve when it came to talking to clients on the page. (017)

Therefore, the public health nurses in this department already possessed a baseline level of competency in the use and functionality of Facebook, which was acquired through previous personal use of the platform. As the Public Health Unit's implementation of the Facebook page became more of a reality, nurses started to *relearn* the platform (e.g., creating group pages and talking to clients on the group page) and its potential functionality as a health promotion tool. For instance, early in the implementation of the Public Health Unit Facebook page, there was limited engagement with the targeted client population. In order to generate more traffic to the Facebook page, a number of modifications were made to both the Facebook page and how the health promotion messages were communicated:

> Oh, we knew it…right out the gate. It was just that we tried some things that perhaps didn't work initially. We thought, okay, maybe cool questions would be a way to engage people. And it worked for a little while, but they wore out their welcome. And so that's when we started thinking about maybe asking them to "like" a [Facebook] status and we'll share tips with them. Things that were fun, but that required minimal effort on the part of the user. And then eventually we figured out that hey, *news stories*. There's so many news stories about breastfeeding. Let's get on that. And that really led to passionate debates and viewpoints from our audience. And that's when we knew that*, okay, we've really hit gold here.* (PHU1)

Once this deeper level of understanding of Facebook's potential for health promotion purposes was realized, the public health nurses continued to refine their understanding of how Facebook could be used even more effectively. Subsequently,

learning the Facebook platform at this stage of the implementation had progressed past developing competencies of using the system; instead, the public health nurses were engineering new and different engagement strategies with the Facebook page to extend the reach and impact of their health promotion message. They learned that in order to build engagement, the Facebook page needed to be socially and technically engineered to be meaningful and relevant to the needs of their clients. To do this, a number of socio-technical solutions were implemented to modify the Facebook platform and the nurses' work patterns to be more directed toward client engagement. Some of these strategies included implementing targeted Facebook advertising to attract new users, embedding *cute* pictures of families and babies that would emotionally resonate with clients, and the branding of specific days of the week for discussion of a particular health topic (e.g., Nutrition Wednesday):

> Another thing from the outset was that we had a difficult time initially recruiting clients.… But it wasn't until we actually started using Facebook advertisements that we started to see an increase in the number of clients that we were getting. And then friends of our new users were seeing…were hearing about us in their news feed and were starting to like our page as well. (PHU1)

> But if we were trying to recruit dads, it was a photo of a dad and a baby and just, are you a new dad? Do you have questions? Come to our page. If it was prenatal moms, again, like, just trying to – trial and error about the text we were using, to really pull people in.… [We also used] cutesy pictures [to draw engagement]. (PHU1)

> We tried to recruit clients. We tried to figure out how to engage them and early on we realized that specialty areas were probably going to be needed to promote what it is that we did so that people would trust us. But also, so that people would become comfortable enough to talk to us. So *Nutrition Wednesdays* was actually, I think, a turning point for when people started to ask us questions because they knew they were talking to somebody who was credible, a primary source of information. (PHU1)

The evolution of the Facebook page as experienced by the public health nurses demonstrated a deeper type of learning that moved beyond basic operation or functioning of the technology. The nurses involved in this situation recast learning acquired from their personal use of Facebook, and transported this knowledge and skill into a new health promotion context. The translation of Facebook from personal to professional use necessitated a number of social and technical modifications in order to be relevant to the population of interest. Similarly, the nature of relearning Facebook was largely spontaneous and informed by the collective actions of other actors and inscriptions in their proximity that subscribed to the importance of the initiative (e.g., staff in the department, Facebook advertising, clients wanting health information, use of cute and engaging pictures, and content themed days). It was the enrolment and inclusion of these proximal actors into the larger actor-network of using Facebook for health promotion purposes that represented the *products* of learning in this situation.

Although the experience and products of learning demonstrated by the public health nurses were remarkably positive, sometimes the products of learning technology

resulted in challenging various established actor-networks for power and agency. For instance, participant 015 outlined her experience observing the dissolution of a cellular phone ban in a hospital that was enforced by the Information Technology (I.T.) department and senior hospital leadership:

> Yes, well, we used to have signs up here: "you're not allowed to use your cell phone." And we were actually asked to stop visitors when they had their cell phones in their hands and say, "Excuse me, you're not allowed to use your cell phone here." And I know, I did it. But then you just can't police it anymore, because – yeah, it was fine when five people out of fifty had a cell phone. But now some people have two [cellular phones]. So you can't stop everyone that comes in the hospital and say, "You can't use your cell phone" (015)

Digging deeper in to participant 015's experience, a more convoluted story of various colliding social and technical forces appear to have forecast the eventual demise of the cellular phone prohibition policy. Participant 015 commented that through growing "public pressure" from the public and clinicians who used mobile devices, the strength of the cellular phone ban was challenged:

> It's all about public pressure really. That one I think everyone's dealing with a little bit, almost kicking and screaming. Because you tell a nurse that she has to leave her iPhone or whatever device she has…you tell them they have to leave that in their locker, in their purse for their shift, *they're not going to*. They're just not – simply not going to. They're going to keep it with them. They're going to be very discreet maybe on how they use it for fear of being reprimanded, if that's going to be the case. Or they're going to be very open about using it. (015)

Participant 015 rationalized that the I.T. department continued to perpetuate the cellular phone ban driven by the fear that they may be able to support or control the "floodgate" of other uses of mobile technology within the hospital's networks:

> because you can't tell me that I.T. staff don't have all their own BlackBerrys and iPhones, right. Like, *they're all doing it as well*. And maybe there is a fear that if they sanction it [using cellular and mobile devices], it's just going to open up floodgates for way too much and they won't be able to support it... (015)

Due to the growing popularity of cellular technology, enforcement by gatekeeper actors like the I.T. department, and emerging clinical functionality of mobile technologies, the prohibition policies at participant 015's organization quickly became archaic. Opposition to this mobile phone ban was further reinforced when nurses and physicians began demanding they be provided access to the organization's network and health information system through their mobile devices:

> Because my colleague has apps on her phone that would support her clinical practice and allow her to do research at the bedside for her patients, medications, et cetera. So that iPhone, where it used to be just a phone, it's [now] a mini computer, right. It's further to the laptop and the desktop and the COW [computer-on-wheels]. Now we have to add in this whole iPad, iPhone, all these other pieces of technology that we haven't had to before…. And we've had physicians challenge [us for] the use of iPads, wanting our software to be able to be accessed and our health information system [to] be accessed from their iPads. We're now having clinicians coming to us *demanding* that we be able to support those devices. (015)

This combination of social forces and growing functionality of technical actors like iPads and iPhones began to recast what technology was appropriate in a healthcare setting. Human actors in this situation were able to evolve their understanding and relearn the use of cellular and mobile technologies in the hospital environment. Correspondingly, the evolving identity of the cellular and mobile technology actors were also endorsed and utilized by human actors to further their cause. This evolving identity of mobile devices was clearly denoted in participant 015's reflection of an iPhone: "[the] iPhone, where it used to be just a phone, is now-- it's [now] a mini computer."

In sum, the human actors in this situation were able to build upon their previous knowledge of the technical actor (e.g., cellular and mobile devices), and recast this learning back into the actor-network of the hospital to confront the cellular phone ban. Learning the technology involved in this situation was represented by the translation of a previously prohibited device (i.e., cellular phone), into a device whose presence was both authorized and valued in the larger hospital setting. These products of learning by human actors were successful in evolving the role, identity, and presence of cellular devices. Therefore, the products of learning demonstrated by the nurses and other clinicians included learning how to rebrand prohibited cellular and mobile devices as a technology endorsed for clinical practice, in order to dismantle a prohibition policy.

Learning Process and Product Summary

As outlined in this section, nurses learned health technology in a variety of unique and distinct fashions. There were commonalities among the experiences of nurses in terms of the process and products of learning health technology; the informal learning reported by a number of participants was an interesting finding. Although formalized

strategies were endorsed as having utility at certain times of the learning process (e.g., when initially learning a new technology), the value of formalized methods seemed to be eclipsed by informal means after an introductory level of knowledge or competency had been acquired. Similarly, the products of learning technology were evident in various changes to actor-networks in the immediate surroundings of nurses. Generally the products of learning were demonstrated through actions taken by nurses to modify or evolve the immediate sociomaterial environment (e.g., implementing Facebook advertising or using a cellular phone despite their prohibition). More significant products of learning technology were only able to emerge after some level of comfort and competency with the technology had been demonstrated by the nurse.

Strategies and Inscriptions: Nurses Learning Health Technology

In the previous section, nurses' learning about technology was described as both a process and a product of various actor-network translations. Although separation between *process* and *product* elements of nurses learning technology can be helpful to demonstrate distinct elements of actor-network translation, the division between these two aspects of learning becomes less salient with increased scrutiny. As actors and networks are translated into new patterns of action, elements of learning that were once represented as procedural in nature can suddenly reappear in modified forms as products of learning. Similarly, products of learning can be recycled into procedural elements. Since actors freely move between levels and structures, attempting to fix an actor (or how it demonstrates or represents learning) to a static location is unnecessary (Latour, 2005). Therefore, given the dynamic nature of learning with respect to nurses and health technology, the separation between the *process* and *product* elements of learning are

more effectively viewed as a perpetual, dynamic cycle. Learning that originates from specific processes (e.g., formal or informal) eventually becomes operationalized into a learning product represented and demonstrated by nurses. As products of learning are established and exercised by nurses, various new learning processes are stimulated and acted upon accordingly by the actors within the larger network. Throughout the remainder of this chapter, processes and products of learning are explored together as part of the larger examples of actor-networks that generate action. In doing so, crystallization of the blurred notion of *process* and *product* of learning will also be elucidated.

Learning Strategies and Inscriptions

Given the dynamic nature of actor-networks where nurses learn health technology, it is sometimes difficult (or impossible) to locate the division between the elements of learning that are procedural in nature, and those that are products. Although differentiation between the processes and products of learning are interesting from an analytical perspective, the importance of stressing their distinctness throughout the larger translation process is not required. For instance, in Actor-Network Theory (ANT), the processes and products of nurses learning technology are viewed as strategies exercised by human actors to *inscribe* behaviours and meaning to non-human technical actors. Lower (2006) defines *inscripts* as artifacts that carry "the programmes of action needed to achieve the goals of the actor-network… [and describing] the inscripts reveals the goals and programmes of actors in the actor-network in question" (p. 101). Inscripts can be represented in a number of fashions, including as verbal or policy artifacts related to technical actors (e.g., smartphone example from Chapter 3). In most ANT studies, inscripts are typically represented in the form of artifacts like texts and signs.

Furthermore, inscripts can also take the form of "institutions, practices, routines or skills" (p. 101) that are created and upheld by powerful actors in the evolving network(s). For instance, nurses using a technological actor in their clinical unit may inscribe their learned appreciation of the system by redeveloping work patterns around the system's use. Although notation of this inscript may never be written or translated into a formal policy document, the nurses on the unit reinforce this practice by collectively modifying their work patterns and through other informal disseminations of the inscript (e.g., teaching it to new staff). These strategies and actions used by nurses to inscribe specific behaviours or meaning to non-human actors is known as *inscription*. Therefore, the operationalization of inscripts can result in the larger action of the inscription of specific behaviours, interests, and meaning onto technological actors. This inscription process can result in ascribing meaning to various actors in two fashions: (a) the inscriptions denote and translate the interests of other actors (e.g., designers of the technology or clinicians using the technology) and project them onto other artifacts and actors of the larger network; and, (b) the creation and negotiation of meaning among human actors as to the nature of the technology being brought into an existing network (e.g., the introduction of the health promotion Facebook page into the Public Health Unit). In this research study, three salient *strategies* exercised by human actors to reinforce inscripts during the inscription and translation processes emerged from the data analysis: semblance, indispensability, and habituation. These strategies were thematically generated through analysis of the human actors' experiences of learning technology, and also through deconstruction of case exemplars. The strategies used by nurses and other human actors represent a conglomeration of learned routines, skills, practices, and

messaging observed during the inscription of health technology actors. Similarly, strategies used by nurses did not always yield positive or beneficial results in terms of the technology being learned. The strategies of semblance, indispensability, and habituation could be operationalized by human actors during the inscription process in a variety of fashions, such as their use as a basis or rationale for the development of effective anti-programs of action. Therefore, it is important to not view the strategies of semblance, indispensability, and habituation as deterministic; rather, these strategies are extremely dynamic and should be viewed as a schema that influences nurses' learning about technology. The implications of these three strategies and their influence on the inscription process while learning technology are presented in Chapters 6 and 7.

Semblance: "It Wasn't Really That Different Than Our Whiteboards" (018)

The strategy of *semblance* resonated throughout the analysis as a significant attribute driving the learning of health technology by nurses. The Merriam-Webster Dictionary (2013) defines semblance as the "outward and often specious appearance or show", or an "actual or apparent resemblance" to something. The most accurate description of semblance in relation to this dissertation stems from the Merriam-Webster Learner's Dictionary (2013) definition: "the state of being somewhat like something but not truly or fully the same thing." Therefore, the word *semblance* will be used to describe an actor's likeness (or its related processes) to another actor in a different context, while remaining different enough in terms of composition to not be identified as the same entity. Along with the semblance of various actors, the commonalities found between various actor-network translational processes will also be described. Subsequently, the following sections will attempt to highlight how this multidimensional

strategy of semblance was represented during the inscription of health technology learned by nurses.

When questioned, nurses generally described learning technology by providing examples of both past and current technology use. Although many of the examples provided by human actors included in this study were disparate in nature, a theme that emerged connecting these assorted examples was related to the resemblance of certain technology actors to other commonly used technology, or the patterns of work they endorsed. For instance, an advanced practice nurse (001) outlined:

> I see technology as the base and then the health technology as the specification, right? Because – and that's how – because I'm constantly thinking, okay, got an iPhone, how can I apply this to my life? And, again, it happens so naturally… it's sort of seamless. (001)

Participant 001 outlined how her conceptualizations of technology blurred together, and that personal technology was constantly considered for repurposing in other elements of life and work. Similarly, participant 001 reinforced that the learning technology was uniquely tied to previous patterns of action that were enacted in different (or new) environments to determine if the technology had applicability or usefulness.

When questioned to provide an example of how technology learned for personal use could be translated into another nursing or health related context, participant 001 outlined:

> the best example I have is for the use of Twitter because that's more recent, I guess, was I was learning about it and I thought, what would I actually share with the world? What do I have to offer? And it was my knowledge and skill. And I

> often look out into cyberspace, let's say, on the Internet and find resources that are really invalid and don't represent my discipline really well…. With my current personal interests that I'm trying to integrate into my workplace as well, the use of social media such as Twitter which is where I share resources again and have conversations with individuals across the world about medical health, nursing and my own personal interests. (001)

In the statement above, participant 001 was able to both observe her current personal use of Twitter, but also propose an extension of this technological actor into her formal clinical nurse specialist role. Regardless, the technical knowledge required to repurpose Twitter from personal to professional usage necessitated a functional baseline of competency with the technological actor. Given the unique culture of Twitter, learning its customs and language was extremely important during her formative phases of using Twitter:

> so what really got me moving with Twitter was an app called TweetDeck and it was actually over lunch with a friend…who said, "Hey, you know what, you should try TweetDeck. It's beautiful." And I agree; it's still beautiful. It's what keeps me organized, because you can have columns and I needed a type of system like that to make it make sense to me as well…. So in Twitter there's language about how you communicate and so… "via @," whatever your [user]name is. That in itself is language. "RT" being a retweet is a piece of language. So learning that was important so I could communicate effectively and try to – communicate with people and finding people…that had similar interests to me. (001)

With the aforementioned technical competencies and understanding of Twitter culture, participant 001 was able to translate her previously acquired skills using Twitter into her professional nursing responsibilities. Therefore, the transference of Twitter use into a new practice environment was achieved in part due to the resemblance of usage patterns and the operationalization of previously developed products of learning (e.g., acculturation to Twitter language, and ability to recognize Twitter's value for information distribution). Since the technical actor itself required no significant modification to operate successfully within the new professional context, the learning that was required by participant 001 to *move* the Twitter actor into a nursing practice domain was facilitated in part by the semblance to the previous operating environment and previously acquired skills. Subsequently, participant 001 was able to inscribe new interpretations of Twitter's functionality and use for healthcare environments through the strategy of semblance. In essence, Twitter became inscribed with the values of participant 001 as a potential tool from which to seek and share information related to nursing and healthcare.

Unlike participant 001's example, the stability of a technological actor's form, process, and function across contexts is not always uniform. For instance, participant 016 described her experiences as a health informatics consultant implementing and educating others about health technology in a very different way. In one example, a label printer for laboratory and specimen vials was to be installed as part of a work contract. The instruction manual supplied by the vendor was not accurate and did not provide any significant insight into the required printer customization to fit the customer's demands:

> for example, we'll get a label printer…from a vendor. And…you might get a manual, you might not…. If you do it's [the manual] not going to match what

> you're using it for. So you end up having to sit down and walk through the steps of what you would need to do, not just to use it, but to do a lot of the troubleshooting, [in order] to be able to create a quick little troubleshooting tip sheet that's user-friendly, for the clinicians to be able to use. And in order to be able to do that or to teach them how to use it, you need to play with it yourself. And write out the steps so that it's user friendly for the clinicians. (016)

Although the label printer lacked comprehensive instructions or directions for its operation, participant 016's previous experiences implementing label printers at different organizations provided her with a baseline of knowledge and expertise to both: (a) operate and setup the printer to suit the needs of the context; and, (b) develop a usable instruction manual for future users. This previous competency obtained over years of various technology implementation and practice as a critical care nurse provided this participant with the knowledge required to translate her understanding and setup of label printers from one context to another. The learning needed to install the label printer in this new environment was facilitated in part due to the resemblance of the various processes and actors learned from previous implementations, and a larger understanding of the printer and its potential functionality. Subsequently, participant 016 was able to inscribe her past conceptualizations and learnings of printers into user instruction manuals to reinforce her interpretation of the printer's role and functionality for other actors in the clinical environment:

> So that's an every-day thing that you see on a regular basis that we have to do some kind of interpretation and provide…do some testing it and write up something to be able to give it to the clinician to be able to troubleshoot and use

> hardware. It's similar when it comes to the software side of it in that…you have a whole manual but because it's been customized for a particular discipline or a particular program you need to translate that into what do I need to do in my day tomorrow and give me the step by step…but not a ton of detail. Just a 'one to ten things' that I need; steps one to ten that I need to do to get to where I want to be. And a lot of that is from testing so…we sit down and start to walk through what it is and then you write steps down and give it to someone else to see if it makes sense before we give it to the end users to use as their cheat sheet. (016)

The strategy of semblance was also evident in the use of an enterprise social networking platform that was trialed for use in a Public Health Unit department. The small scale pilot project involving a Facebook-like social networking platform named *Yammer*® was distributed informally to a few colleagues and members of the Public Health Unit for pilot testing purposes. Yammer is described by its website as "*a tool for making companies and organizations more productive through the exchange of short frequent answers to one simple question: 'What are you working on?'"* (Yammer, 2008). The interface of Yammer is similar in layout and functionality to Facebook, but is only accessible to individuals in a specific organization. Subsequently, Yammer can operate like an intranet or other collaborative management systems (e.g., SharePoint) that are used for internal communication purposes.

Yammer was first pilot tested at the Public Health Unit to a limited pool of five users. Given the similarity of the platform to other social media sites (namely Facebook), its adoption and use by pilot users was extremely rapid. Within a few days of the Yammer pilot project going-live, the members of the pilot test began sending Yammer

membership requests to other non-Yammer users within the Public Health Unit. Over the next month, the word *Yammer* evolved into a verb within the Unit's vernacular (e.g., "I'll Yammer you that…"), and the platform continued to attract more and more users. After one month, more than 200 employees had become registered users of Yammer. By the end of four months post implementation, the use of Yammer had swelled to more than 400 registered participants (as reported by participant 023). The implementation and testing of Yammer was also preplanned by the coordinating manager to be as naturalistic as possible, as there were "no official rules or guidance" (017) presented upfront to direct the use of the platform in the organization. During the entire four-month process, the manager in charge of the Yammer pilot monitored the platform usage, provided minor suggestions to registered users, and addressed any emergent concerns related to posted content. Public Health Unit nurse 017 described her experiences with Yammer:

> I found out about it one day when my supervisor and I were waiting to present to council; we were going to talk to them about our Facebook page. And the director of the region's external communication strategy [Director] told us that, hey, "I just heard about this thing called Yammer and myself and [Manager] started using it". They invited a few people. So he told them to check it out. And he briefly described that it was a social network, kind of like Facebook, but you would use your [Public Health Unit email] address and it would be a closed group for [Public Health Unit] employees; my impression was that there was no official rules or guidance or anything in place. It was just, okay, get on there, play around with it and see what you think. And then email me your feedback…. But once I got on it the blue and white made me think of Facebook but then I guess the

> professional sense kind of made me think [of] LinkedIn. And suddenly it had grown all these people…all these colleagues that I work with within my division and outside of my division had already started to join. And people kept joining and joining and joining. (017)

The semblance of Yammer in terms of appearance and functionality to other platforms like Facebook and LinkedIn was clearly articulated by participant 017. The nurse manager (023) in charge of the maintenance and rollout of the Yammer pilot project was both surprised and impressed by the uptake of the Yammer platform. From participant 023's perspective, she believed Yammer was successful for a few reasons, beyond the mere technical semblance of the platform to other commonly used social media technologies. For instance, participant 023 outlined that a recent report generated by the Public Health Unit recommended that internal communication processes be improved to assist with information flow and transfer across the organization. Similarly, it was noted that the social element of communication was highly coveted and sought out by the participants who were surveyed during the generation of the internal report:

> people really like to be social and they have a need to be connected. They have a need for face-to-face communication and if they can't have that, let's do some communication tools, like all the social media tools. That [theme] came up again and again and again [from the report]. Why are we just using email? Our Intranet is not the best; it needs to be worked on. We want to know what's happening. Why can't we use wikis or this or that or for collaboration. We want to work together. We want to collaborate. Let's use all the new technology that's out there to do that. (023)

As outlined by participant 023, human actors at the Public Health Unit prized the ability and process of communication with others in the work environment. Equally, human actors also sought to extend or complement their current repertoire of communication modalities beyond the current state of traditional face-to-face interactions and email exchange. Given this espoused need, participant 023 was able to select a platform that she believed would extend the current communication patterns and functionalities of both human and non-human actors in the Public Health Unit. In other words, human actors who adopted Yammer were able to quickly do so because they likely had already subscribed to the value of social communication that they experienced through similar platforms like Facebook. The potential value and familiarity of the platform to human actors was described by participant 023:

> I think it's the people, the age that they are…the Net-generation. I think it's their expectations on how they want to communicate…. It's a natural way for them to communicate. Just like our citizens expect, you know, just to go online to order pizza. Those citizens are also our employee, that's our people that work here. And a large majority of them, I think it's almost more than half, are basically people who use this kind of technology in their everyday life and they're going to expect to use that at work…. So, of course, I think it's only natural that they would bring that into that mode of communication into the workplace…it's the social piece and, because all people want to have social, but also it's an expectation now. This is the way we communicate in the world and you need to get on. You need to get onboard with that or you're going to be left behind. (023)

The learning demonstrated by human actors using Yammer seemed to be facilitated by two salient inscripts translated onto the Yammer platform: (a) the similarity of the technical actor and its potential functionalities to other platforms like LinkedIn and Facebook; (b) the familiar social communication processes endorsed and expanded by the Yammer platform. It is likely that the developers of Yammer had operationalized the strategy of semblance during the platform's development in order to inscribe the role and function of the communication platform to align with other similar systems (e.g., LinkedIn and Facebook). Similarly, participants 017 and 023 clearly articulated that they actively inscribed elements related to their desires for social communication upon the Yammer platform. Subsequently, the use of the semblance strategy as a means to influence inscription of the role and function of Yammer within the Public Health Unit appeared to be effective and quickly adopted by other human actors in the proximity. Therefore, it would appear that the semblance strategy exercised by Yammer users in this case likely acted as a catalyst in the platform's adoption by human users.

Indispensability: "I Would Feel Pretty Lost Without It" (011)

The root word of indispensability, *indispensable*, possesses a variety of definitions. As an adjective, indispensable engages the notion of being "absolutely necessary or essential" or "incapable of being disregarded" (Dictionary.com Unabridged, 2013). As a noun, it is defined as "a person or thing that is indispensable" (Dictionary.com Unabridged, 2013). From the perspective of this dissertation the term *indispensability* will be used to highlight how a technical actor, or the process it endorses, is learned by human actors to be essential or necessary for larger operation of the actor-network. Furthermore, it is important to appreciate that indispensability does not speak

to the quality of the technical actor, or if it is liked by its human actor users; rather, the notion of indispensability is a strategy exercised by humans that focuses on how a technical actor is positioned as a requisite entity, or becomes inescapable in the lives of human actors.

The strategy of indispensability was typically alluded to by human actors through their descriptions of technology they used in both everyday life and nursing practice. Correspondingly, a wide repertoire of technology was identified and discussed by all human actors interviewed in this study. Technology including cellular phones, biological monitoring devices, electronic medical records, point-of-care devices, and other more abstract technologies like computer software and the Internet were described and highlighted by human participants. One element of learning technology that resonated through many human actors' descriptions of technology was how a specific technological actor became *indispensable* to their current life or work processes. For instance, one nurse undertaking graduate education outlined her close proximity to her iPhone in the following statement:

> I have my iPhone that is attached to my hip now. I use it from morning till night. It's my alarm clock in the morning, all the way through using it to check what the weather will be the next day, you know, late at night. So I'm really connected through that…Internet I use all the time. It's not just research but for, you know, I read my newspapers online…. Anything I want to find an answer to, the first thing I do is Google it. Yeah, so that's pretty standard. I probably spend most of my day on the Internet. (011)

This closeness to the iPhone was further reinforced by participant 011 who stated that she

would be "pretty lost" if the was phone taken away or misplaced for any length of time:

> I would feel pretty lost without it. I have on occasion forgotten it [iPhone] when I'm out and it's the first thing I realize that – I don't have my phone [Laughs]. What am I going to do? And, yeah, I think realistically…life would continue on and I would still get everything done. Maybe even more so. But I would lose that sort of feeling of being connected, you know, when I'm out and if somebody needs to reach me I know that they can…I use it in such weird ways sometimes…I'm out shopping and I see something I like, I'll take a picture of it to think about it later. Or I use it to document little things like that. And if I didn't have it I'd feel like I was maybe losing out on very, very small opportunities... Realistically I think it would be certainly manageable. But I would feel like I didn't have that connectedness…. I think it's a sort of security thing, too. I feel like I always have that ability to reach someone if I need them. (011)

Although participant 011 was able to clearly rationalize that "life would continue" without immediate access to the iPhone, the relationship between participant 011 and the iPhone demonstrated the device's value and importance within this nurse's larger network. From acting as her alarm clock, Internet browser, and communication device, the iPhone had become an indispensable actor in her daily work processes, and its removal (whether hypothetical or real) engendered reactions of loss and uncertainty.

Upon moving to a new city to seek advanced education, the indispensable nature of the iPhone appeared to have rapidly evolved due to participant 011's change in environment and social surroundings:

> because as soon as I went to [City A] I only had the iPhone. I didn't have a landline [telephone] so I was using it [iPhone] a lot. Everyone that I worked with immediately exchanged cell-phone numbers in order to be texting so we could communicate on when we wanted to go out for lunch, when we, if we were going to do something after work. My entire [social] circle…would text in that manner to arrange last-minute get-togethers and that sort of thing. So I was using that. I started talking to people when I walked into work and back. I started using it for that and then I didn't even have an alarm clock so I started using it immediately for that purpose as well. So it became all of a sudden integral as soon as I was in [City A]. And I became reliant on it and even when I returned full time to [City B], I still used it constantly. (011)

It would appear that the iPhone only began to represent and be recognized as an indispensable technology to participant 011 when other previously important actors in her network where either displaced or compromised. For instance, the iPhone actor became extremely important to participant 011 upon moving to a new city where the desire to remain connected to friends and colleagues reinforced the importance of the device in daily life. Other important actors that were left behind in the previous city were replaced by the iPhone in a both useful and acceptable fashion (e.g., alarm clock). The strategy of inscribing traits of indispensability onto the iPhone appears to be a learned reaction stemming from both participant 011's immediate needs (e.g., alarm clock), and those of other meaningful actors in her network (e.g., remaining in contact with friends through text-messaging). Subsequently, participant 011 used the strategy of indispensability to reinforce the inscription of the iPhone actor as a requisite feature in her daily work and

personal life. Therefore the learning that surrounded the iPhone stretched beyond the basic processes and competencies of operating the phone; rather, the learning of the device was demonstrated by the translations made to participant 011's network, reinforced by the various inscripts mandated by other actors (e.g., alarm clock and friends) and inscribed onto the iPhone actor.

Other human actors interviewed in this study voiced similar strategies of inscribing the notion of indispensability onto technological actors in their immediate work or life environments. A nurse educator (013) found the Canadian Nurses Association portal NurseONE had become an indispensable teaching tool that she used in many of her nursing curricula. A clinical informatics manager (004) described feeling "lost" without her corporately provided BlackBerry. Finally, a nurse-informatician (015) claimed that the use of the electronic documentation record system had become so important to the role of the nurses at her organization that many work processes could not occur without the presence of the technological actor.

Although the strategy of indispensability was typically reported in a positive tone by human actors (e.g., *I need this actor to perform daily activities and it makes my life better*), other interpretations of the strategy were uncovered when highly influential technical actors were not readily available or actively malfunctioning. For instance, participant 002 outlined her reaction to the downtime of a hospital information system in her healthcare organization:

> I think now we've reached the phase where sometimes technology – some level of technology is the norm…no one wants to write anymore. They'd rather use a computer. In my current job I rely so heavily on it, that you know, if the

> computers are down…it's almost like you can't work, because all your information is in the computer somewhere. (002)

Participant 002 appeared to appreciate the value of the hospital information system, but also retained a critical perspective of the technological actor, related to how overly dependent other (namely human) actors had become on its existence.

Another nurse manager (003) working in clinical informatics also voiced responses similar to those of participant 002 in terms of the over-reliance on a specific technological actor to underpin daily work process:

> we've had our EMR [electronic medical record] server crash and it had to be rebuilt from tape…lived through that twice actually…that's why you have good downtime procedures because we already had, you know, different backups for what we had determined by criticality or of what do you need to treat this patient. How far back does your data need to go in order to move forward? Do you really need the CBC from seven days ago or is the one three days ago good enough? And then you can move forward until we get the EMR back up. (003)

Interestingly, the EMR actor described by participant 003 had become so indispensable to clinical and legal functions within the hospital that the EMR necessitated a backup system to preserve its integrity in the event of failure. For instance, participant 003 described the second failure of the EMR as occurring roughly three years after implementation of the EMR.

Along with managing the technical failure of the EMR system, participant 003 also had to appease clinicians and staff who had fully adopted the electronic record

system and were demanding to know *when* their ability to document electronically would return:

> So if it [the EMR failure] had happened when we first went up with some of our electronic processes, nursing in particular, because they're more vocal than allied, might have said, oh, great: 'we get to go back to paper'. But it happened about *three years* downstream from when we first went up [with the EMR]…so at that point it was, like, okay, 'when are we going to be able to document again'? (003)

Therefore, it would appear that the EMR had become resiliently inscribed as an indispensable actor for clinical delivery processes and its unplanned downtime caused significant disruption to clinicians and staff. Subsequently, over the three years of the EMR operation, the inscription of this technical actor as requisite in care delivery was learned and reinforced by human actors in the network. The EMR's sudden disruption in service demonstrated its power and agency in the network, including the Blackbox network that had been fashioned around use of the EMR by human actors.

Another demonstration of a network containing an indispensable technological actor was recalled by a new graduate nurse (009), while outlining her use of an iPad and iPhone during her undergraduate clinical education:

> So just having the iPad with me, having everything I needed on it, sending emails right away, having the RNAO best practice guidelines, making notes. I would be able to type up some of my papers on it and summarize my email. So it became so much more functional and I became so much more an efficient student and nurse subsequently. But it was a little difficult because in other placements I became so used to my iPad…then when I was on the [other] floor I obviously

> couldn't have it. Like, even at the nurses' station. So I would just carry my iPhone with me and use it similarly…. I guess they just don't want you doing personal things or what they deem as personal use at the nursing stations. So really you're not supposed to bring your laptops or anything. And I guess the iPad would be no different. (009)

The new graduate nurse was able to use her iPad in one clinical setting as a student to assist with her information access and record keeping; however, in another clinical placement, a number of cultural and social pressures impeded her from using personal handheld technologies to support patient care:

> I think it's really a cultural thing because not that it's to say the older generation that works in healthcare looks down on this sort of thing. But I think they just don't understand it so they're really fearful when people bring stuff in like this or even their iPhones, because they focus on the negative aspects that could pertain to this. Like people taking pictures and breaching confidentiality. So that's really what they focus on instead of, 'oh, she's bringing her iPad or iPhone so she can do research' or what have you. So I think it is sort of a cultural/generational gap, lack of knowledge on a lot of their parts. (009)

Therefore, although she found her iPad and iPhone to be important in one clinical setting, the negative conceptualization of the technology by other human actors in a different clinical area prevented participant 009 from *officially* using the handheld devices. Subsequently, the network that had been arranged and learned by participant 009 in relation to her iPad-iPhone use for clinical purposes was interrupted. Her strategy of inscribing the iPad-iPhone as an indispensable actor in the new clinical area was not

endorsed by other actors in the environment. Regardless, participant 009 continued to use the iPad-iPhone in this new environment, in direct opposition to the inscription developed by other human actors (e.g., fear, focus on the negative aspects handheld technology, or potential breaching of patient confidentiality). The continued use of handheld devices by this participant (i.e., "So I would just carry my iPhone with me and use it similarly" [009]) also demonstrated the enactment of an anti-program to challenge the fearful and negative inscription of handheld technology held by human actors in the new clinical environment. Subsequently, participant 009's enacted anti-program was effectively implemented and she continued to discreetly use her iPhone, circumventing the wishes of other human actors who continued to reinforce their fearful inscription of handheld technology and its potential negative consequences.

The strategy of reinforcing or accepting the indispensable nature of certain technology appears to be a feature learned by some nurses using health technology. In order for nurses to continue to use a technology in practice, some level of inscription related to the indispensability of the technical actor is required within the larger actor-network where action is occurring. That said, the strategy of indispensability is not dependent on human actors appreciating or *liking* the technology in question; rather, technology that is or becomes indispensable may be despised by its human users, but is learned and inscribed by human actors to be vitally important to the generation of action.

Habituation: "I'm Actually Petrified of Computers, if You Must Know" (007)

The development of habits related to technology was an important strategy used by nurses learning technology. El-Khatib and Barki (2012) define habit as:

> a mental construct that is functional and goal directed, difficult to control, executed without awareness and is mentally efficient. …[W]hen people repeatedly and satisfactorily perform the same behavior in response to a cue in a stable context, the link that is created in their mind between the cue and the behavioral response acquires a degree of automaticity. (p. 2)

Findings from this study suggest that nurses used past interpretations and usage of technology as framing mechanisms to inform new learning. This strategy of habituation also entailed the development of habits and opinions related to using a technology, which were eventually inscribed and translated on to various technological actors in the immediate network. Over time, inscripts driven by habitual actions were used by nurses to guide and strategize future decision-making processes related to new technological actors introduced into established networks. Subsequently, the learning of future technology appeared to be highly influenced by the interpretation and recollection of past inscripts affixed to various technological actors.

From this perspective, habit and time appear to be linked concepts when describing the learning of health technology by nurses. Time is required for nurses to develop habitual understandings of the technology they use; subsequently, time is required to inscribe this learning onto the technological actor. In the following example a new graduate nurse (010) described her previous "anti-technology" stance and general dislike of technology. Through deconstruction of her scenario, it was found that she had used previously stabilized inscriptions of technology to guide future learning of technology. Similarly, this reinterpretation and recycling of past inscriptions served to reinforce her fear of technology:

> Initially, when I began the BScN program, I think I was anti-technology because a lot of the, I guess publicity around it, is very negative. You know, your privacy is being invaded. You're trying to delete your pages or posts or whatever, and it's not really being deleted. And it's almost like I was very negative toward technology. And then just because of that area of not having your…personal privacy always being there, I guess is what I was saying. And so I didn't really go on to, like, hi5 and Facebook, any of that stuff. (010)

Digging deeper into the reasons and rationale for her previous fear and anti-technology stance, interesting realizations emerged related her initial exposure to various social media technologies, and the context in which they were learned:

> And then as I began the BScN program and I started getting along with my colleagues and some tutors, et cetera… maybe I'll dive into this a little bit more. And when I say I was anti-technology, I wouldn't even upgrade my phone or anything. I'm good with the basics [in terms of a cellular phone]. I'm actually surprised I was like that, honestly, especially considering my age and the generation that we live in. And after I started the BScN program, obviously everything was done online. Hard copy is very…it's almost old-school, if I'm allowed to say that. It's not something that you do very often anymore. And so during the BScN program, I got more into it and I became a part of things like LinkedIn and I had Facebook, but…I utilize[d] it [social technologies] a little bit more. But I made sure that…I wasn't having certain pictures or certain quotes or, you know, I made sure that it was still almost professional, just because I don't know who's looking at it at the end of the day. And I don't have Twitter, just

> because I didn't really see the point of having somebody follow me and vice versa. (010)

As participant 010 spent more time reflecting upon her previous reluctance related to technology (especially of the social media genre), it was uncovered that she had been an early user of a peer-to-peer messaging software (MSN Messenger) eight years prior. During her early use of MSN Messenger, participant 010 had observed some of her friends posting sexually suggestive and provocative images and status updates online:

> And then I think MSN was the big hit at the time [eight years ago]. And I was very into that, a lot. And I remember that people used to put their statuses up and their pictures up, et cetera... I just remember reading and seeing a lot of pictures of things that I don't think should have been posted. People didn't know how to use it, is what I'm going to say…I just saw some of the girls in my grade…grade eight, grade nine, just trying to, and what I perceived, is trying to use it for attention. And I will say sexual attention. And I think that was one thing that really turned me off, and the fact that males would respond to it however they wanted to. I think that was the biggest issue... So I guess in retrospect, the fact that some of my classmates, who I respected, because they were smart and they were funny and they had all these personal characteristics that were great about them. But the fact that they were using this [MSN] to show pictures and write these things and have these guys be okay with it. I think that was the thing that really frustrated me. *And I don't think that I really leveraged other social media technologies after that online because of that. I think that's why* [italics added]. (010)

It would appear that the past learning of MSN Messenger and the negative connotations inscribed around socially-distributed online communication influenced her future patterns of social media use. The MSN Messenger technology both failed to become an important actor in her network, and was actively inscribed by participant 010 as a technology that resulted in anxiety from its use. Subsequently, other actors that resembled MSN Messenger were actively ignored as time progressed due to the original negative learning experience that had been translated into a formative inscription in participant 010's network. Therefore, the strategy of using habituation to learn technology resulted in the reinforcement of a Blackbox network around participant 010 that actively avoided all types of social media technologies (past and future).

Other examples of habituation were also highlighted by human actors describing their (or others') learning of health technology. The *initial learning* of a technological actor appeared at times to have significant impacts on future use. For instance, intensive care nurse participant 007 outlined her current trepidation as it related to her first interaction with a personal computer:

> I'm actually petrified of computers, if you must know. And I say that in such a way…this was a long time ago, my husband brought home this, I think it was, I don't know, a P.C. or one of the very first computers. Anyway, he gave me a quick, you know, rundown, it was very brief. My husband is not a great teacher so, I kind of got what I could out of it and I did something to the computer; froze it for five days. So it took him a really long time to straighten it all out, so since that time…that was my very first learning experience on it and it was very

> unpleasant. *It was like learning to drive a standard and having your husband teach you on a hill in North Vancouver* [italics added]. (007)

Like participant 010, participant 007 suffered from an initial negative experience related to a technological actor that appears to have shaped her future experiences and interactions with various technologies. Upon questioning participant 007 as to her current fear related to technology, her response reaffirmed that she was not clear on how the actor operates or functions:

> Well, you know, I still have – I'm very – I guess because I don't understand the whole – the system, how it internalizes all that stuff, so I'm unsure of what's good and what's bad. (007)

Along with the original negative learning experienced by participant 007, it also appeared that other actors actively collude together (whether purposeful or not) to reinforce the inscription that certain technologies should be feared:

> You hear all these stories and, really I haven't heard any person – but television, sensationalism that goes on – a long ways. But there's some people [who] do get into a lot of trouble and I've no interest or desire, you know. And I guess that's what my biggest fear is…that somebody's going to access my information. Now I have [two sons] in my household, so they tell me terrible stories as well. So I would be the person who would probably get…something would happen, you know? (007)

Participant 007's current fearful conceptualization of technology appeared to have been learned and reinforced over numerous years by both herself, but also by other actors in her larger actor-network (i.e., husband, two sons). Therefore, it would seem that

elements of fear and anxiety developed as part of an inscription of computer technology used in daily work and personal life. Like participant 010, future learning of technology continued to draw on past experiences using habituation strategies which reinforced the inscription that computerized technology should be feared or avoided.

As outlined above, unfavourable or fearful learning experiences of technology appear to have the potential to negatively affect future learning of technology and its use. Nevertheless, negative learning experiences can sometimes generate positive outcomes, depending on the resiliency of the human actor and other supportive actors in the immediate networks. For instance, participant 014 outlined her experiences learning computer and Internet-related technologies in the late 1990s in her role as a nursing union leader. Although her initial experience was negative, supportive actors in her larger actor-networks were important in facilitating her ongoing learning and eventual inscription of Internet technology as a positive work and communication tool:

> I know…when I first got on the Internet, gosh, that was in the '90s and it was so slow…I gave up on it, I just said oh, *this is ridiculous*. But it wasn't till things sped up that it became of interest to me and I know I was one of the few people out of 350 nurses, the organization I worked at the time, who had a computer at home. And the only reason I know this was that I was president of the union at the time, so I really did get to talk to a lot of people and there was only one other person I knew who had a personal computer at home and it was her husband's, but she used it. And trying to get people interested in using a computer and trying to show them the functions and the benefits to it was really quite interesting. (014)

Given participant 014's position as union president and access to a personal computer allowed her to move past her original reaction to the technology as ridiculous. Subsequently this participant's learning of technology as a positive aspect was reinforced due to the various roles she performed in the organization and as union president. As she continued learning about technology, the previous negative ideations she held began to become routinized into more positive outlooks:

> It is, and I had that [previous] experience with the Internet, but I remember thinking this will get better, it will improve, I'll come back in a year…Yeah, it'll get done, you'll figure it out. You're not stupid, you'll figure it out. It'll all work itself out…I tend to do well when I get that nudge first. So if somebody shows me a few things then I get it and then I can take it from there and actually I do want to take it from there. But I do need some, I don't know, people to show you the lay of the land a bit…. I know where South Africa is now, not just the continent of Africa. I know where things are, so it takes the person who's giving me the nudge less time to get me where I'm independently looking for things. (014)

Although participant 014's learning of personal computer and Internet technology was a multi-year experience, the habituation strategy used by participant 015 occurred in a relatively expedited fashion. This nurse clinician and nurse informatician described her experience learning how to operate an automated dispensing unit (ADU) that was used to dispense and record access to medications. *Fear* appeared to be participant 015's initial reaction when confronted with the actual use of the ADU system in an Intensive Care Unit (ICU):

> Well, one that scared me, has just gone in the ICU, is the ADU, Automated Dispensing Unit for medications. I'd had my training. I hadn't worked for quite some time, and then when I went back in to work, my [login] access didn't work. So I had to get someone to help me get my access up, and I was just totally sure that I was never going to be able to do this thing. And it was so easy… [laughs]… And at the end of the shift, I joked that I had made friends with it. (015)

Participant 015's initial concern and trepidation with the potential use of the ADU appeared to be multifaceted in nature, underpinned by both her lack of recent ICU work and the time that had elapsed since her previous ADU orientation training:

> I think it was because I had been [ADU] trained and didn't get to use it. So if I had been trained and then gone into the ICU and worked for four or five shifts and then…was able to use it right away and remember everything that I had learned, it would have been a lot easier. But it's not the nature of how I get to work. I have to take things as they come and do the best I can. So it had probably been two months before I'd actually got to use it [the ADU]. (015)

Interestingly, participant 015 outlined her unmet desire to match formalized learning of the ADU (i.e., the ADU training) with actual practice and use in the clinical environment. It would seem that the delay to operationalize the learning acquired from the training session halted the potential development of habits related to ADU use in practice. It appeared that the delay between learning a system and its actual use in practice negatively influenced participant 015's perspectives of the technology. Fear and concern resonated when participant 015 described initially having to use the ADU in practice.

Regardless, participant 015 was able to persist despite these barriers and become functionally competent with the ADU in her nursing role. Utilizing assistance from other clinicians and following the instructions presented by the ADU, participant 015 was able to become reasonably comfortable with the ADU over two clinical shifts, and make "friends" with this non-human actor:

> Yep, we'd made friends, that ADU and I. Yeah, it's kind of cute that I did that. So it was a piece of technology that was a little bit daunting…in the end, didn't turn out to be that at all. (015)

The process of which participant 015 undertook to become "friends" with her non-human ADU colleague also reinforced various habitual elements that needed to be fostered and internalized. Her reduction of fear appeared to be related to her increase in confidence with the ADU, repeated access and use of the system, and enabling prompts provided by other human actors in the environment:

> So morning meds is eight o'clock, and I knew I'd had my training and I knew I couldn't keep asking everyone for help, like I had the previous shift. So I just tried to go in and be calm. [I] was to keep myself from panicking, giving up and going getting some help. Just stopped and took a deep breath and worked through how to use it. Now I had to get help because some of the medications are still stocked. Some of them are in the ADU. Some are in the refrigerator. I couldn't remember how to get into the refrigerator…but by the end of the shift, you're pretty much in the ADU every hour, hour and a half, two hours. So the more I used it, the more I felt like I could function independently and give it a try. And then by the end of the shift, I was learning more complex skills, like, wasting

> medications, which is fine to withdraw medications from it. But then to actually say, okay, I didn't use this much of this narcotic. I have to now record that it's going to be wasted. So how do I do that? So I was moving on to another level. (015)

Along with receiving informal instructions from human actors in the environment, the non-human actor of the ADU also provided a significant amount of direction and insight into its function and use. Participant 015 outlined that the ADU communicates with its human user through various flashing lights and audible beeps to help direct clinicians to the location of various medications contained within the device:

> In fact, I realized how much value there was in the ADU the last time I was in, because I didn't know where to find the metroprolol. Well, using the ADU, the drawer lights up and says, "Hey stupid, here it is." Do you know what I mean? ... it lights up and says, "here it is" [in reference to the desired medication]… you go in, you select your patient, you select the drug you want and you select the dose you want. And the drawer lights up, and it actually clicks and beeps. And then when you open the drawer, there'll be…say 20 compartments of medications, and the one compartment that has the metroprolol in it, will light up and beep as well. And when you open the lid, it lets you open the lid. Whereas if you tried to open another one, it would alarm and say, "No, this isn't the right one." …It's like a string search. It chunks you down until you find the one you need. (015)

Therefore, building on the learning obtained through the formal ADU training session, participant 015 was able to co-construct various patterns of future learning and use behaviour through the assistance provided by both human and non-human actors in the

environment. Over time she was able to rework her process of medication administration in practice around the ADU actor, and become familiar with the technology. Although participant 015 conquered her initial fear of the ADU, her use of the system was far from being Blackboxed. Participant 015 outlined that although her initial fear had subsided through conquering the ADU over the course of two clinical shifts, the learning of the technical actor was an ongoing process that required repeated interactions over time:

> So that fear is gone now 'cause you've conquered it once. But still in the back of your mind, you realize that you're going to have a bit more learning to get back to what it was at the end of your shift…. The shame of it is I don't have another booked shift yet. So I will have to probably go back to about half of what I had achieved in terms of learning, and I'll have to drop back down. But I know that, and then work up again through the shift to that level of comfort again. (015)

Although participant 015's fear related to the ADU may have diminished, future interaction with the ADU was required to develop refined habits surrounding the technical actor's use and functionality within the Intensive Care Unit. Regardless, important inscripts related to the use and role of the ADU in patient care were developed over her two clinical shifts. Since participant 015's interactions with the ADU resulted in a positive learning experience (e.g., she was able to make "friends" with the ADU by the end of her clinical shifts), she felt optimistic related to her future usage of the system. Unlike participants 010 and 007 who developed negative and fearful inscripts related to their learned technology, participant 015 was able to inscribe various positive realizations and learnings onto the ADU system.

Summary

Throughout this chapter, learning about technology by nurses has been explored in two primary ways: (a) examinations of the processes and products of learning; and (b) the strategies used by (or upon) nurses to develop inscriptions related to technology use in larger actor-networks that generate action. In both sections, numerous actors and their involvement in actor-network translation have been described and analyzed.

The findings presented in this chapter have been largely drawn from disparate examples of nurse-technology relationships collected from different human actors over the course of the research process. Emergent themes related to the process/products and strategies of learning technology were elucidated through the lens of ANT. To further refine the findings presented in this chapter – namely, the three strategies of semblance, indispensability, and habituation – three distinct case exemplars are presented in Chapter 6. Explored are how these learning strategies led to the development of resilient inscriptions within confined environmental contexts. Through the analysis of case exemplars, the operational value and importance of the three strategies and their resulting inscriptions related to nurses learning technology will be further reinforced.

Chapter 6 – Case Exemplars: Learning Strategies in Action

In Chapter 5, the strategies of semblance, indispensability, and habituation used during the learning of technology were introduced and described. Three case exemplars drawn from the research data and presented as findings in this chapter are used to demonstrate and reinforce the importance of these learning strategies. Through analysis of the three case exemplars (i.e., Public Health Unit, Urgent Care Unit, and Complex-Continuing Care Unit), the actions and behaviours of nurses and other human actors learning health technology are highlighted and further described. Each case exemplar contains a detailed description of the background of the situation, and analysis of the learning strategies and translational process experienced by nurses.

Case Exemplar 1: Public Health Unit

Background

In early 2010, a Public Health Unit located in a large urban centre in Canada began the process of developing an official Facebook health promotion page to target new mothers and families seeking information related to breastfeeding and parenting. The need to develop new information distribution strategies was originally realized sometime in 2009 when leaders of the unit noticed a decrease in the volume of phone calls to their contact centre related to public health issues. Along with the decrease in call volumes, it was also noted that "a lot more people were turning to contacting us in ways other than telephone calls…people were starting to contact us using their [cell] phones and using email, and that was pretty new to our health department as a whole" (PHU1). In response, the supervisor of the Parenting and Breastfeeding team initiated a

pilot project to test the functionality of using a Facebook page as a new communication avenue for clients in the health region. Clinicians, technical support staff, communication specialists, and the Public Health Unit's website committee began the process of developing a formal business plan for the development of a Facebook page for the Parenting and Breastfeeding team. By mid-2010, the formalized business plan had been completed, and was subsequently approved by the Medical Officer of Health of the Public Health Unit for a six-month pilot project to test the functionality of the Facebook page.

The original intent of the Parenting and Breastfeeding Facebook page was to improve access for consumers to contact the Public Health Unit and obtain information related to parenting and breastfeeding. Throughout the generation of the business case, the project was met with skepticism from a number of leaders, clinicians, and other health department staff. Given the relative newness of social media in 2009-2010, the department conducted various informal and formal education sessions with key stakeholders in the organization to highlight how Facebook operated and its potential functionality as a mechanism for online health promotion. Given the public nature of Facebook (i.e., all conversations posted to the Facebook thread are viewable by anyone with Internet access), there were a number of legal, professional, and security implications that were carefully negotiated in the business plan approved by senior leaders and the Medical Officer of Health.

The initial six-month pilot project was budgeted to require two full-time equivalents of nursing service. The main role of the nurses in the originally conceptualized project was to generate content for the Facebook page related to parenting

and breastfeeding, to moderate and respond to questions posted on the page by users, and to redirect sensitive questions to the Public Health Unit's call centre. During the early phases of the Facebook implementation, nurses spread their workload between their normal duties, and the maintenance and development of the Facebook page throughout the work week. Initially, consumer engagement with the Facebook group was low, but did rise in popularity, in a way that corresponded to the nurses' increased knowledge and skill in engineering adept engagement strategies and messaging.

As consumer engagement increased, further strategic targeting of consumer populations was undertaken through the use of advertising and analytic software native to the Facebook platform. Facebook Ads and Facebook Insight Analytics were purchased to better target and capture usage data of consumers accessing the Public Health Unit Facebook group. Upon conclusion of the six month testing phase, the pilot was deemed a success and the project was extended. In one year, the Facebook group had garnered more than a million page views, and was assigned as a permanent service offered by the Public Health Unit in late 2011, after final ratification by the Medical Officer of Health.

Learning Strategies

Three important strategies to learn technology were exemplified throughout this case scenario: (a) the realized and demonstrated indispensability of the Facebook page to the health promotion activities of clinicians; (b) the semblance of the Facebook page to the nurses' previous use of other social media technologies; and (c) the development of habits related to the use of Facebook in the professional roles of nurses that were translated over time into robust networks of perpetuated action.

Indispensability

The indispensability of the Facebook page was demonstrated in this situation in a number of ways. The system users (e.g., nurses, communication staff, and other clinicians) confirmed the important nature of the platform for daily operation of the service delivery mandate of the department (i.e., health promotion around breastfeeding and parenting issues). The growing popularity and success of the Facebook implementation was also noticed by other human actors in the Public Health Unit, namely, senior leadership and management:

> It's a permanent program [Facebook page], permanent service that we offer. So yeah, it's in our portfolios…. Officially, December of last year [2011]. But that was after the six-month mark. It's just we had to meet with the medical officer and do a demo for him, and at that point, he gave us his blessing. (PHU1)

In order to ensure the longitudinal success of the Facebook page, modifications to the nurses' workflows and resource allocation in this department were made early on in the proposal for the page, and reinforced over time with the continued success of the platform. For instance, two full-time equivalents of nursing staff were requested to ensure appropriate coverage was offered by the nurses to guarantee regular posting of material and response to users' questions. Workflows of the nurses who were assigned to the page were modified over time to best align with the evolving nature and use of the Facebook page:

> Well, we generally post a minimum of three posts a day. So we kind of just pick a topic that you want to talk about that day or a variety of things. We all kind of

> do it differently, whatever you're comfortable with. But we mainly develop posts or come up with our first post and then as the day goes on, kind of figure out the rest of them. And we just make our post, do some research on the news feed, see what's new, check out the news articles. And if questions come up, we're answering those. If we have to consult with some of our backups, we do that. (PHU1)

Although many of the indispensable traits of the Facebook page were learned and operationalized by the staff who used the system most (e.g., public health nurses), the evolving strategic directions of the Public Health Unit as a collective also endorsed the *just-in-time* nature of the page and its content. For instance, members of the Facebook team described the strategic directions of the Public Health Unit and how communication strategies that offered "just-in-time" connection to health information were being sought for future development:

> One of our strategic priorities for [the Public Health Unit] – it's basically looking at interventions and how to… [create]…behaviour change… for our target demographic. And one of the things that was noted very highly, almost above all of the things, is the idea of *just-in-time* interventions. So the idea of meeting parents, kind of when they need us. And it's not only when they need us, but it's also where they are…. Or [they] might not want to come in to a class, and they might choose the Internet as their route to doing it. And what that research told us was that indeed people…don't want to kind of have to bend what they prefer…. And so that's been brought up in the discussion about Facebook internally ever since that research was conducted... [our Facebook page has] proven [to be] the

> opening factor that this was based on…was a demographic that we quite possibly weren't reaching, and that this was a way to grab them in a way that they would respond to. (PHU1)

Finally, indispensability of the Facebook page was also demonstrated through its positioning in many of the involved actor-networks. For instance, currently a link to the department's Facebook page is prominently displayed on the Public Health Unit's website, with a description of the type of interaction that might be experienced by a user. Additionally, by searching key words related to the geographical location of the Health Unit and various parenting and breastfeeding related terminology, the department's Facebook page consistently ranks as a top result in the Google search findings (as of May 2013).

Semblance

Prior to the implementation the Facebook page, the nurses and staff who were the primary drivers of the project claimed to be users of Facebook for personal purposes. This prior knowledge of the platform and its functionality assisted both the comfort level of staff implementing the page and its use in a health promotion role:

> I think also just because all four of us were [previously] comfortable with Facebook and it was an exciting experience for us; that it was a bit of an easier transition. (PHU1)

> I mean, we knew social media – everyone knows social media, who doesn't now have a Facebook page, right? (017)

Along with the technical semblance of the Facebook platform, the evolution of the platform into a health promotion tool required some significant social modifications

in terms of usage and privacy policies. For instance, all members of the department were required to develop Facebook accounts that were separate from any personal account the nurse or staff might possess. This was accomplished by creating accounts using their corporate Public Health Unit email addresses. Similarly, policy around *friending* users was developed in order to maintain boundaries between the nurses' personal lives and their professional role online.

Finally, the mode of communication that Facebook endorsed also seemed to be preferred by one of the nurses involved in the implementation and use of the Facebook page. The nature of the communication provided by Facebook (e.g., written, as opposed to oral, and carried out at each user's convenience rather than synchronously) was appreciated by participant 017, as she outlined a number of situations whereby she would prefer to use online technology to communicate rather than other forms of verbal communication:

> Even in my own life, not so much my practice, but in my own life…I don't really want to talk to people on the phone. I'd much rather be talking to them online. I'd rather order a pizza online. I'd rather do a lot of things online. And I know a lot of people in my demographic and age group feel very similarly. (017)

Interestingly, how nurses learned the Facebook page for the Public Health Unit appeared to have been facilitated by both familiarity with the platform in personal use, as well as other elements of online communication. The use of Facebook in the role of the nurses was not a significant technical or conceptual leap from the clinicians' previous personal use. Subsequently, repurposing the previous skills and competencies of

Facebook and its usage was accomplished (and perpetuated) due to endorsement of the project by Health Unit leaders, and, the continued successful consumer engagement.

Habituation

As outlined previously, the process and products of nurses learning to use Facebook as a health promotion tool in a Public Health Unit required a number of socio-technical alterations. Although the nurses were comfortable using Facebook for personal purposes, the redeployment of the platform into a professional health promotion generated a number of habitual responses demonstrated in the nurses' learning and use of the page.

For instance, early on in the rollout of the Facebook page, nurses claimed that they were unclear on how to best create and target messages to consumers that would be engaging and meaningful:

> I think in terms of how we changed, how we were hosting [the consumers virtually]…definitely I felt like getting comfortable with the idea of moving to more, *fun hosts,* rather than just [presenting the] official messages or links to our own page…. And each other's personality started coming out on the pages. So let's say [Nurse A] was coming on… "I'm here today to talk about this." A comment from a fan of the page, "Oh, good morning. Good to see you back [Nurse B]," or [Nurse C] or whatever. *So it was very formal at the beginning*. (PHU1)

Over time, nurses using the Facebook page learned to reduce the level of formality of the posts, and generated more targeted and personalized messaging related to their individual expertise or backgrounds:

> But I think as they got more comfortable with their own sort of style, their personalities came out on each of the days. And then I think people started to associate it [each nurse's personality and demeanor]. And then I think also too, they started pushing themselves, you know, "I'm a public health nurse in the breastfeeding program," and started talking about their expertise. And so then following the Nutrition Wednesdays, they started saying, you know, "I'm a breastfeeding nurse…with the child health program." Then the questions started coming out beyond just nutrition…. That sort of thing. So we started promoting our own expertise and that sort of brought up some of the questions. (PHU1)

With this growing development and understanding of how to interact with consumers via Facebook, other aspects of using the platform began to formalize into habits, whereby the tone and clarity of messages posted to consumers began to evolve from declarative statements into more meaningful and engaging messages. For instance, early in the development of the Facebook page between April and May 2011, the level of engagement with consumers was noticeably low. Although the nurses maintained a daily presence on the page, most comments posted would only receive a single *like* or reply. Similarly, the use of online polls was wide-spread during this period (e.g., a primary question, with three or four potentially correct options to select from), although failed to draw meaningful engagement from consumers.

The refinement of engagement strategies continued through a process of trial and error, and by the nurses maintaining a current knowledge of the Facebook platform and its emerging capabilities. For instance, leading into late June 2011, the approach to engaging consumers via the page began to subtly shift from messaging from the

perspective of the Health Unit department, to a more personalized strategy of signing each post with the nurses or clinician's initials. Prior to June 13th, all messages posted to the Facebook page by staff were written in a manner that did not identify the author of the posting. For instance, a common type of message posted to the Facebook page prior to June 13th included:

> Know someone who is expecting twins, triplets, or more...? Here's a great site where parents of multiples learn from each other. Find the group nearest you! [URL to a prenatal resource] (PHU-FB)

After June 13th, messages posted to the page began to be signed by the clinician's initials at the end of each message. Over the next few months, more and more consumer participation with the site was noted (in the form of replies and *likes*). For instance, at the end of June, a user of the site posted requesting information on "good daycare centers" (PHU-FB) in a large Canadian city. This message was met with responses from both the Public Health Unit clinicians, as well as another user who provided her suggestion about where to find information related to high quality daycare centres. Similarly, other clinicians (e.g., a dietician) at the Health Unit began to participate on the Facebook page, using personalized and identifiable avatars (e.g., containing their full name, avatar photo, etc.), and taking specific health questions related to their areas of expertise.

By the fall of 2011, the Facebook page began to stabilize in terms of consumer usage and interactivity. A repertoire of returning regular users was noted throughout the message transcripts. The clinicians using the Health Unit's generic account also evolved their signatures left at the end of their messages from the author's initials, to their first name:

> Giving birth soon? Just remember these four things: Walk, move, change positions and breathe. It all helps your baby move down :) ~ [Nurse's first name]. (PHU-FB)

Corresponding to this time period, a new engagement strategy of requesting users to *like* a comment posted to the page before a response was initiated. For instance, in September 2011 one of the clinicians posted:

> How do you know when you are in true labour? For the first 8 people who "Like" this status, I will give a sign of true labour. (PHU-FB)

This message received eight *likes* from various Internet users and was subsequently responded to by the clinician who posted eight health promotion tips related to the signs and symptoms of labour. This engagement mechanism of requesting users to *like* a hypothetical or rhetorical question continued to see use throughout 2012 and into 2013.

Over 2012, the use of the Facebook page continued to increase in terms of engagement (as witnessed by the growing number of comments and likes per post) and through the use of other media like videos and images. Consumer-generated posts outlining recommendations for parenting related services (e.g., clothing and toy recommendations) also became a common occurrence. Some parents started posting examples of their baby and family portrait photos to the Health Unit page, complete with referrals to photographers. Other parents posted images related to discussions or topics discussed previously on the Facebook page. In follow up to a discussion related to car seat safety, one parent posted images of his children properly secured in a vehicle, complete with a narrative explaining the installation process of the car seats.

By the summer of 2012, stabilization of the Facebook page in terms of engagement strategies and consumer participation seemed to occur. Engagement strategies like polls had become obsolete and were no longer used, while other strategies including requesting users to *like* a rhetorical health-related question continued to engender participation. Similarly, the personalization and information contained in the postings left by staff appeared to be more fluid and less rigid than messages posted in the year previous. Clinicians continued to sign their first name at the end of postings and increased the use of other images or videos attached to their main post. Along with some of the traditional health-related information discussed, the clinicians and staff implemented humorous messages and media as a further engagement strategy. For instance, one post in the summer of 2012 used the *fill-in-the-blank* approach to garner responses from consumers, as it requested people respond to the following question: "One thing a partner should NOT say during labour and delivery is _____ " (PHU-FB). This posting was complete with an image of a mother holding two newly born twins, and received 18 comments, and 4 *likes*. Similarly, humorous Internet memes related to parenting issues were routinely posted by clinicians and staff. Below is an example of an Internet meme cartoon posted in August 2012, which received seven *likes*, with a corresponding supportive comment from a Public Health nurse:

If this reminds you of how you're feeling or how you used to feel, know that it gets better :) Parenting is a whole new experience and you'll learn as your baby

> grows and develops. We're here to help! Post questions about your new baby on our wall, visit our website (WWW.URL.COM) or call us at XXX-XXX-XXXX Mon.-Fri. 8:30am-4:30pm. Have a wonderful night :) ~[Nurse's first name]. (PHU-FB)

It would appear that over the nearly two years of operation of the Public Health Unit's Facebook page, a variety of learnings regarding the use of the platform for engagement with consumers was acquired. Although the *type* of health information (e.g., parenting and breastfeeding) posted to the page did not change over the two year period, the mechanism and tone of delivery underwent significant evolution. Many of these learning actions were demonstrated by the nurses in their actions to personalize their messages (e.g., leaving their initials or first name at the end of each post, or discussion of specific health related topics based on the nurses' or clinicians' expertise). The reinterpretation of how health content was posted and interacted with by consumers also represented a significant learning achievement by the nurses. The discontinuation of poll questions in favour of other higher yield engagement strategies was a salient representation of learning the Facebook platform within a health promotion context. Over time, this knowledge was passed among the nurses and clinicians of the department, and became part of the work process and habits endorsed online. This learning was described by a group member's experience of the situation:

> The parents started giving each other input, which is what we were looking for in an online community, right, for them to help each other out, us being kind of the referees... certain things worked out a lot more. We found they were receptive to certain techniques, like, fill in the blank or myth or fact kind of questions. Like,

> they were engaging more with the fun type topics. So we kind of decided to… put a little bit more fun in there, and that got the numbers up a little bit more too. 'Cause it was not all dry information that they were looking for. They were looking at sort of interactive things, right. (PHU1)

Overall, the habits learned, developed, and repeated over time was an important element of using the Facebook page in a health promotion context. The internalization of activities and mechanisms that worked effectively at drawing engagement from consumers were increased and reinforced, whereas strategies that were either ineffective or failed to yield desired results were dismissed immediately. The implementation of Facebook Insight Analytics and advertising also functioned to reinforce the learning of habits related to the system use. The Analytics and advertising solutions, implemented between July and October 2011 (PHU1) provided real-time statistics related to the number of user views and other web-related engagement metrics (e.g., unique webpage views). The combination of these two approaches enabled the clinicians to build processes and behaviours online to increase engagement with consumers, and to generate new learning around Facebook and its role in a health promotion context:

> we tried some things that perhaps didn't work initially. We thought maybe *cool* questions would be a way to engage people. And it worked for a little while, but they wore out their welcome. And so that's when we started thinking about, okay, maybe asking them to *like* a status and we'll share tips with them? Things that were fun, but that required minimal effort on the part of the user. And then eventually we figured out that hey, 'news stories'. There's so many news stories about breastfeeding. Let's get on that. And that really led to passionate debates

> and viewpoints from our audience. And that's when we knew that, okay, we've really hit gold here. (PHU1)

The nurses and clinicians striking "gold" in terms of their participant engagement formula demonstrated an important tipping point in learning the Facebook platform for health promotion.

Currently (as of Spring 2013), many of the same habits that were generated during these formative learning experiences have become important engagement processes used by the nurses in current operations of the page. Subsequently, the habits formed during this important initial implementation and use of the platform became important modifiers of action, shaping not only the work-processes of the nurses, but also the visual representation of health information presented on the Facebook page.

Case Scenario 2: Urgent Care Centre

Background

An Urgent Care Centre (UCC) located in a large, urban city in Ontario was selected for inclusion as a case scenario through theoretical sampling processes. The UCC provides urgent healthcare services for patients of all demographics in the surrounding urban and rural areas. The UCC is not an Emergency Department, but rather a healthcare facility that delivers health services for conditions and illnesses that should be managed or treated in an urgent fashion (e.g., fevers, infections, cuts, broken bones, etc.). The UCC also has the equipment and personnel required to stabilize patients in medical crisis for transportation to higher acuity healthcare facilities.

Since the UCC manages a variety of patient populations, streamlined information management systems are extremely important to ensure that efficient care can be

provided by clinicians. Given the complexity of managing various types of patients presenting with a variety of different primary concerns, the workflow and processes in the UCC are complex and chaotic. Similar to Emergency Department workflows, patients are triaged in terms of their medical acuity, based on the type and severity of their presenting signs, symptoms, or conditions.

In an effort to help organize the location, treatment status, and medical attributes of each patient, a tracking board system was used by clinicians and staff in the UCC. Prior to 2004, a manual tracking board system consisting of large whiteboards with erasable markers was used to capture, organize, and translate patient information. As of 2004, an electronic tracking board called FirstNet replaced the manual tracking board system. The implementation of the FirstNet electronic tracking board was a significant change in the UCC and had substantial implications related to how nurses (and staff) learned to use the new tracking board technology. In order to fully describe the features and elements of learning the FirstNet tracking board, a detailed description of the work processes of the manual and electronic systems is first required. The following sections will describe in detail the workflows of both the manual and electronic tracking board systems in the UCC.

Manual tracking board. Prior to the implementation of an electronic tracking board in 2004, a manual system was used to organize and track patients' progression through the UCC. The information captured on the tracking board was translated from clinical documentation initiated by the triage nurse. Upon entry to the UCC, a patient was assessed by a triage nurse stationed at a booth opposite the UCC's waiting room. The triage nurse assessed the patient and determined the presenting condition,

requirements, and triage acuity level. The patient was then forwarded to the registration clerk who would obtain the patient's health card information and register the patient in the hospital records. Depending on both the patient's acuity and bed availability in the UCC, newly triaged patients would either be directed to the waiting room, or immediately directed to a bed in the UCC.

The triage nurse in conjunction with a duty nurse would be in charge of organizing patient flow through the UCC, and determining the availability of beds and assessment locations for both admitted patients and those placed in the waiting room. To accomplish these tasks, clinicians and staff used a network of manual tracking boards to organize patient movements in the UCC. The manual tracking boards consisted of erasable whiteboards and non-permanent markers positioned at various intersections of the UCC that aligned to clinician and staff's pre-designated clinical assignments. This network of manual tracking boards formed a larger system that facilitated information transfer between clinicians by conveying the basic identifiers and locaters for each admitted patient to a specific section of the UCC (e.g., name, bed location, chief complaint, assessment status, physician, etc.):

> We used to have whiteboards at the major nursing intersections. And so at the desk we would have just a whiteboard and it would have listed the different beds. And we would write the person's name beside it, so the people that were working there could look up there and say [Patient A] is in room one. And they would add additional information that was important to remember like "ultrasound at one o'clock." Or "physician to reassess" or anything like that, they were separate.

> The only way you would have knowledge about that is you would have to walk to those boards. (018)

The updating and management of the information on the manual tracking board was the responsibility of the nurses assigned to each section of the UCC. Typically two nurses were assigned to 8-10 beds within their section, and responsible for managing, updating, and maintaining the integrity of their manual tracking board (along with delivering nursing care to their patients in this area).

In conjunction with the manual tracking boards, a vertical filing basket with numerous slots was affixed to a wall and served as both as an assessment triaging system and centralized ordering system for all medical and treatment orders:

> so if you had a patient that needed to be seen…you'd put their name up [on the whiteboard], you'd walk the chart [to the vertical filing basket], you would look at the order in which the patient was being seen. And you would put them—"oh, this one is in emerg and I'm going to put them second from the top…" *[*closer to the top of the filing basket denotes a higher level of patient acuity or importance as interpreted clinically by the nurse or clinician*]. And the physician would only be aware of that person when they went over and picked up the chart. Sometimes they [physicians] would quickly view down [the filing basket] and say, "Who is there [in the UCC]?" (018)

Communication between clinicians and staff with the older manual system relied heavily on verbal or telephone communication. Since there was no master tracking board encompassing all the patients in the UCC for clinicians at the triage desk to place a patient in a bed, a number of manual tasks needed to be completed to locate the suitable

bed. Therefore, bed availability in the UCC was manually accomplished through a number of formal and informal techniques: (a) overhead paging; (b) phone calls to specific areas of the UCC; (c) walking to the section and asking the clinicians located there, or checking the section's manual tracking board; (d) verbally yelling across the UCC toward clinicians working in the desired section; and (e) using an extra staff member designated as the *team leader* to facilitate bed flow and patient movement across the UCC:

> if you had a really sick patient you would have to, and we did this all the time, overhead [page] *doctor so-and-so* to this room and then when it wasn't necessary that you overhead, but you needed them to see them, you'd have to go find them. So all of your communication was either by boards or it was by going and getting the person or calling in. Triage would have to call in and say, "Hey, do you have a bed back there, I have a really sick patient." Because they didn't want to leave triage to walk in to look at your bed board and you would have to go…. Yeah, basically, all overhead [paging] or – the phone was constantly ringing, do you have a bed in there, you know, and the whole bit. Now it was great when we were flush with staff and we had someone who was sort of like the team leader that would kind of go around and check. Because then they would just have to yell for the team leader and say what do you have, and they kind of always had to kind of have a mental memory of what beds were available. (018)

Although appearing unpolished, the manual procedures described above operated as a relatively stable actor-network to manage both patient flow and healthcare information. Regardless, the manual procedures were reliant upon the various human

actors (i.e., clinicians and staff) and their shared expertise and ability to synthesize disparate information communication strategies. This information network did fail on occasion, especially when patients were (or became) lost or temporarily misplaced. Patients became *lost* if their physical location in or outside the UCC became unclear. This would happen on occasion if a patient was sent for treatment outside the UCC and the transaction was not noted on the tracking board. Patients would sometimes become lost in transfer between sections of the UCC, resulting from failure to update the tracking boards. Figuratively, a patient would become *lost* if their inscription (e.g., patient chart, presence on tracking board) became misplaced or was moved by another human actor accidently or intentionally.

FirstNet electronic tracking board. The FirstNet electronic tracking board is currently used by all clinicians and staff to help organize, exchange, and track information related to the status of patients in the UCC. The electronic tracking board was first implemented in 2004 and replaced the previously described manual tracking board system. The infrastructure required to implement the FirstNet system necessitated outfitting the entire UCC with computer terminals and monitors at each nursing station to ensure that all staff had access to a computer. Similarly, mobile computer-on-wheels terminals were also deployed in the UCC to provide mobile access to clinicians when required. Currently, clinicians of the UCC have a one-to-one ratio of clinician-computer terminals (either fixed or mobile).

The computer terminals located in the UCC provided access to the FirstNet platform. Information conveyed via the FirstNet tracking board system was represented in the form of a dashboard showing all the UCC patients, organized by room number, and

further customized to the nurses' assigned patients. Specific colour codes and icons on the dashboard represented different occurrences and situations (e.g., a red cross icon beside a patient's name denoted that the patient had yet to be assessed by a nurse). Nurses were responsible to update their patient's status on the FirstNet dashboard for all interactions. For instance, after the initial assessment of a patient, the nurse would document this interaction on the dashboard by "check[ing] off" the assessment. Upon completing this action, physicians working in the UCC would receive a notification on their dashboard that the patient is ready to be assessed:

> When the nurse completes her assessment she has to manually go in here *[mouse clicks to a specific section of the dashboard under the patient's name]* and check off that she has completed it, that she's completed it…. As soon as this comes up *[a specific dashboard icon]* that person's name gets dumped into the physician's [dashboard] and the physician now knows hey, I have a patient to see, okay. (018)

Elements of FirstNet also replaced the manual vertical filing basket as the order entry system. Along with the implementation of an electronic order entry system that linked data with the FirstNet dashboard, clinicians and staff were able to see in real time, through various coloured icons and prompts, medication and treatment orders that were pending or completed. Communication in the UCC also changed from the previously described manual process. Since the status of each bed could be quickly observed by glancing at the FirstNet dashboard, reliance on overhead paging and telephone calls to specific nursing stations for bed status updates diminished in frequency.

Although the FirstNet tracking board provided immense advantages to both communication and patient information flow, there were a number of difficulties faced

during and after system implementation. One of the most significant issues was related to the previously developed triage process. Historically, patients entering the UCC would first present at the triage station for assessment, and then proceed to the registration clerk to be entered into the hospital records. With the implementation of the FirstNet tracking board and other elements of electronic documentation, the processes mandated by these technological actors required the entry of various patient identifiers (e.g., name, date of birth, presenting concern) before an electronic patient file could be generated. Therefore, since the triage nurse was the first interaction a patient had with the UCC, it was determined that the triage nurse should enter the patient demographic and assessment information into the electronic record and FirstNet tracking board.

Soon after initiating the FirstNet system, various unintended consequences began to occur. Some of these consequences included the duplication of patient records and transcription errors in the charting record. These errors were rationalized as the result of a multitude of factors, including triage nurses' lack of patience to perform clerical data entry tasks and the subjectivity of various patient names (e.g., maiden name versus married name) (018). Due to the structure of FirstNet and the electronic documentation system, correcting duplicated records or errors was very labour-intensive and cumbersome. The length of time required to complete an electronic triage assessment also required significantly more time than the previous manual system:

> if you don't get the right person and you now chart a triage documentation on them [electronically] and you realize after you had the wrong person, you can't copy and paste everything [into the correct patient record]…you have to cancel

> that and redo it…. At one time we used to just have one triage nurse, we almost routinely have two because electronic triage does take double the time. (018)

A workflow redesign was undertaken to address the various unintended consequences generated by the addition of the FirstNet and electronic documentation actors. Instead of patients first presenting to the triage nurse, all patients were requested to first "quick register" with a registration clerk who would add their basic demographic details and health card information into the FirstNet and other electronic records. After the quick registration phase, the patient would visit the triage nurse for assessment where the nurse would complete a basic assessment, and document this electronically using the patient file generated by the registration clerk.

Learning Strategies

Two important learning strategies were exemplified throughout this case scenario: (a) the indispensability of the FirstNet tracking board for nurse work behaviour and process; and (b) the semblance between the electronic tracking board and previous patterns of work behaviour and learning. These two strategies are discussed in the analysis that follows.

Indispensability

Given the tracking board's central positioning in virtually all patient care communication and information exchange, the tracking board (in both manual and electronic forms) was learned to be an indispensable actor in the larger network of the UCC. The transition from the manual to the electronic tracking board reinforced the indispensable nature of the tracking board in the daily work processes of the UCC and its staff. Subsequently, nurses learned to use the FirstNet system because of its

indispensable relationship with the larger network of actors within the UCC. Since conducting the nursing role in the UCC would be difficult (if not impossible) without some sort of patient flow organization tool, the electronic tracking board was not viewed as a foreign or overly intimidating technological system; rather, it was seen as an evolution of the previous established pattern of behaviours involving whiteboards and erasable markers. As it plays such a central part in the nursing role in the UCC, learning the new FirstNet tracking board as demonstrated by nurses extended far beyond mere technical competency with the system interface and dashboard. The knowledge learned was represented in various practice modifications made by UCC nurses and other staff to accommodate the nuances and eccentricities presented by the electronic tracking board. The indispensability of the platform was demonstrated by the accommodations made to workflows and the roles of human actors in the UCC. For example:

- The entire triaging process of patients was designed to coordinate seamlessly with the work process mandated by the electronic tracking board. In doing so, the roles of the triage nurse and registration clerk were modified to align in a more coordinated fashion with the processes dictated by FirstNet.
- Nurses changed their communication patterns related to seeking bed status availability across the UCC, after the introduction of the electronic tracking board. Use of overhead paging, use of telephones, and yelling across the UCC to determine the bed status of a specific area was reduced or eliminated.
- Misplacement of patients (both physically and figuratively) in the UCC was reduced or eliminated through the development of a new tracking code that was possible with the FirstNet tracking board.

- Geographically, nurses realigned their work processes around specific computer terminals located in their sections of the UCC, to ensure ready access to the FirstNet tracking board. On computer terminal screens observed in the UCC at the various nursing stations, the FirstNet tracking board dashboard was maximized on every screen. During shift change and verbal reports to other staff and clinicians, the FirstNet dashboard typically acted as a central information repository to both direct and highlight various clinical care considerations. During one shift change observed, a nurse providing a report to a colleague pointed at each patient's name on the screen, gave a brief summary of the patient's immediate health status, and also opened various tabs on the record to explain procedures and medications that were pending administration.
- Nurses' clinical work processes were evolved to accommodate the FirstNet electronic tracking board as the centric hub of patient relevant information. For instance, all nursing stations were outfitted with computerized terminals that allowed individual access to the FirstNet tracking board. The tracking board was later preprogrammed with an auto-logout function after two minutes of non-activity to help ensure privacy and security of patient related information. Previous to the FirstNet platform, the whiteboards containing various potential patient identifiers were clearly visible by staff and patients (and visitors) at all times.

Semblance

As outlined above, the learning required by nurses to adopt the electronic system did not appear to be overly burdensome. Given the aforementioned learned

indispensability of the tracking board actor, basic platform adoption was viewed more as a necessity to staff rather than an optional competency. The physical resemblance of the electronic tracking board to the older whiteboard based system also appears to have facilitated quick uptake and learning. For instance, the visual appearance, layout, and arrangement of information on both the manual tracking board and electronic tracking board were similar to each other. The types of information conveyed by both the manual and electronic systems were largely identical (e.g., name, room, presenting condition, other various status updates). Nurse educator 018 outlined the semblance between the manual and electronic tracking board in both role and function:

> in one way…*it wasn't really that different than our whiteboards* [italics added]. You wrote what bed they were in, their name, you might put their age, and usually put reason for visit. Your name was beside them, you might put [in] the doctor [name]. (018)

Overall, learning the electronic tracking board appeared to have been facilitated by the resemblance of the electronic actor to the preceding manual actor. Further evidence of this resemblance between manual and electronic actor is demonstrated in action during planned and unplanned downtimes of the FirstNet tracking board. During outages of the electronic tracking board, protocols dictate that manual tracking board systems be utilized to continue operations and care delivery until the electronic system is brought back online: "We…go to our downtime procedures and virtually what we do is go back to a 2004 type" (018).

Although the physical nature of the two tracking board actors resemble each other, there is also a certain amount of work process commonality between the two

systems that remained static amidst all the workflow redesign that did occur. For instance, the implementation of the FirstNet tracking board and its corresponding electronic documentation capabilities modified virtually all human actors' (e.g., nurses, registration clerks, other clinicians, staff, and patients) previously established patterns of behaviour in the UCC. However, these workflow and process changes did not seem to be radical enough to disrupt the overall composition or stability of the UCC actor-network. If anything, the changes in behaviour witnessed by the human actors served to reinforce the importance and value of the electronic tracking board actor to the larger network.

One work pattern that evolved with the introduction of the electronic tracking board (and the corresponding electronic documentation capabilities) was the use of computer terminals in patients' rooms. Early in the rollout of FirstNet, computer terminals were trialed in individual patient rooms to allow nurses access to chart at the bedside. Nurses were uncomfortable with the ability to chart in patient rooms due to the potential for confidentiality breaches. Along with privacy and confidentiality concerns, nurses also noted a socially-driven desire to continue to possess their *own space* to conduct documentation and intraprofessional collaboration:

> we put computers in every…patient room. We thought people would go in there and do it, they don't. And part of the reason that the nurses tell me is they want to come back where they're in their space and people aren't talking or that…they can look things up. But also in the patient room they didn't want to go and look at the next chart just in case they [patients and visitors] could see for confidentiality. (018)

Quickly, computer terminals within patient rooms were abandoned and relocated back to the traditional nursing station areas of the UCC. This work process revision better aligned with and resembled previous patterns of work behaviour and fulfilled a social element that was missed when nurses were forced to chart individually without the ability to ask questions or vet concerns with nursing colleagues.

This desire by nurses to possess a private space away from patients was also evident in the physical arrangement of the computer terminals in the UCC. At the beginning of a shift, nurses selected a specific computer terminal at a nursing station in a section of the UCC close to their assigned patient roster. Over the course of the day, nurses generally preferred to return to the same computer terminal selected at the beginning of shift. In an effort to denote a computer terminal as *taken*, nurses placed their personal belongings around the computer terminal (e.g., coffee mug, jacket on corresponding office chair, etc.). Attempting to use a nurse's terminal without permission also sometimes had the tendency to engender aggressive responses by the nurse who had claimed the computer and the physical location around the terminal:

> You're there [in reference to a physician]. Don't touch our computer, you're there [pointing to the location of the physician's computer terminal]. (018)

In these ways, the introduction of the FirstNet and electronic documentation reinforced nurses' previous work processes of conducting patient documentation and reporting at a common nursing station. Subsequently, electronic documentation in patient rooms was abandoned and computer terminals were provided at nursing stations to match the previous work process of nurses documenting at centralized hubs.

Case Scenario 3: Wall-mounted and Computer-on-Wheels Devices

Learning health technology by nurses in the previous two case examples (i.e., Public Health Unit, and Urgent Care Centre) appeared to be largely positive experiences for the human actors involved. For instance, nurses learned to translate the use of Facebook into a health promotion context in order to engage consumer populations. Similarly, the FirstNet tracking board offered a number of advantages for nurses to assist and evolve clinicians' workflow and information distribution. In essence, the learning experienced by human actors resulted in the building and strengthening of preexisting and new networks of practice revolving around the newly implemented technological actor. Regardless, not all instances of learning about technology results in the effective integration of a new technological actor into the larger actor-network. In the following example, the implementation of wall-mounted and computer-on wheels devices in a Complex-Continuing Care Unit will illustrate how technology was not always positively received by nurses or internalized by these human actors as useful or indispensable. Also described is how the learning strategy of habituation was compromised through the shifting of actors in the Complex-Continuing Care Unit actor-network.

Background

During the late 1990s, many healthcare organizations experimented with the use of wall-mounted and mobile devices in an attempt to optimize clinicians' workflows in practice. To accomplish this goal, computer terminals were affixed to walls in hallways and patient rooms, and generically referred to as *wall-mounted computers*. Other computers terminals were placed on mobile stands with wheels, powered by rechargeable battery packs and connected to the hospital information system via a wireless network.

These mobile computers became colloquially known as *computers-on-wheels* (COW). Originally, the implementation of wall-mounted and mobile COWs was conceptualized to enable clinicians to access and document patient-related information at the point-of-care. It was also hypothesized that busy clinicians would find documentation at the point-of-care to be advantageous for both workflow and efficiency purposes.

Following this mantra, a large early adopter healthcare organization in Ontario decided to install both wall-mounted and mobile COW terminals as a pilot project to test the functionality and use of these devices. One unit selected for inclusion in the pilot project was a Complex-Continuing Care Unit. The Complex-Continuing Care Unit was a 40-bed adult inpatient unit for patients with complex medical needs who were not suitable for long-term care or residential settings. Nurses working on this unit were "apprehensive" (022) about the implementation of the wall-mounted and COW devices, as it presented a significant change from the previous paper-based documentation system that had been historically used for all patient care records.

In order to sensitize staff to the role of the wall-mounted and COW devices, the implementation of these devices was positioned strategically to coincide with the larger activation of a hospital-wide electronic medical record (EMR) that would be used for clinical documentation purposes. It was hypothesized that nurses would require increased access to terminals in order to document electronically, and the addition of the wall-mounted and COW devices would offer an adequate solution to this access issue.

Leading to the activation of the EMR, staff were given the opportunity to learn to access the new EMR system with the wall-mounted and COW devices in both formalized

and informal learning sessions held in the unit. Extra assistance and support was provided by the clinical informatics department to assist clinicians in redeveloping their future workflows related to clinical documentation and patient care. Although a significant amount of effort and training had been provided to clinicians prior to and throughout the go-live of the EMR, a number of unintended socio-technical considerations became apparent in relation to clinician use of the wall-mounted and COW devices. A deconstruction of these unintended considerations and how they are related to two specific strategies of learning by nurses are explored below.

Learning Strategies

Two important learning strategies were exemplified by the nurses and other powerful actors in the larger network in this case scenario: (a) the prescribed indispensability of the wall-mount and COW devices (by the clinical informatics department), which was consistently questioned and challenged by nurses; and (b) the dissolution of nurse habits developed around the use of the wall-mounted and COW devices for electronic documentation due to changes in the composition of the Complex-Continuing Care Unit actor-network.

Indispensability

Less than a month into the implementation of the wall-mounted and COW devices, concerns related to the reliability of the devices became known to the clinical informatics department. The hydraulic arm used to lift the keyboard and monitor of the wall-mounted devices to an acceptable user height had broken on many of the terminals deployed on the unit. To compensate for the failure of the hydraulic lift arm, nurses propped the keyboard and monitor in place using lotion bottles and other materials found

around the unit. The situation was vividly recalled by participant 015 (nurse informatician and ICU nurse) who assisted with the wall-mounted and COW implementation:

> We had advocated and installed wall-mounted computers in all of the patient rooms…and I'm not even sure why, but we decided to do a round, just to see how things were going, and I think we got told that one of the devices in one of the rooms was broken. And so we decided to go around and check on how things were. And I would say 60 percent of the devices were broken. The hydraulic arm that lifts it up and down on the wall had broken, and they had stuck lotion bottles in the hydraulic to stop it from dropping…down too low. (015)

The COWs were also suffering from technical issues on the Complex-Continuing Care Unit where they had been deployed. Due to the antiquated nature of the computer technology in the COWs (i.e., slower computer processor), many of the nurses became frustrated with the slow system performance and ceased using the terminals. In the cases where the COW became either too slow to operate to the clinician's desired pace or stopped functioning properly altogether, they were cast off to a corner of the unit and abandoned. As participant 015 outlined, nurses did not request to have broken or malfunctioning devices fixed by the appropriate technology support services; rather, the devices were simply abandoned en masse:

> Instead of thinking that they should have that [wall-mounted device or COW] fixed… if it broke, they would stuff it into a corner and just move on. So to us, it was…very evident that there was an apathy. When it breaks, no one's going to fix it. So I either band-aid it or I stuff it in a corner, forget about [it], and find

> another way to work. So the 'dusty COWs', I'm going to call them for lack of a better term, that were pushed into corners if they took too long to load or if they wouldn't start up…will get relegated to the corner and not used and they'll [nurses] find another workaround. (015)

In spite of the numerous technical faults of the devices, use of the wall-mounted and COW devices remained an important access point for nurses and other clinicians to access the EMR system. Given the professional responsibilities of nurses to document patient care, the use of the EMR system was not voluntary. Therefore, the indispensability of the wall-mounted and COW devices was ascribed to the nurses by other actors from the larger network of action (e.g., the clinical informatics department, College regulatory requirements, and EMR system). Regardless, given the numerous technical faults of the devices, the nurses actively challenged this indispensability by generating a number of workarounds and other subtle anti-programs. Through these anti-programs, nurses demonstrated *their* learned interpretations of the devices' indispensability within the larger actor-network. In one example, nurses affixed a poster to an inoperable COW outlining that the device had metaphorically "succumbed" to Mad Cow disease:

> And at the time, it was the time of Mad Cow disease. And oh, my gosh, there were posters taped onto devices: "This one succumbed to Mad Cow disease," it was pretty hilarious really. But it was sad…from another perspective because you realized how quickly they [nurses and staff] develop workarounds. (015)

Along with the Mad Cow example, other nurse-sponsored anti-programs emerged throughout the implementation of the wall-mounted and COW devices, largely in

response to the dissolution of previous work patterns that possessed both cultural and social significance. For instance, prior to the implementation of the wall-mounted and COW devices, the documentation practice exercised by nurses on the unit was to save the majority of their charting responsibilities for a slower period of the shift (typically around 14:00-15:00). In order to keep track of clinical information collected over the shift (e.g., patient status and progress notes), nurses used an informal system of note keeping on scraps of paper, and later transcribed this clinical information into the appropriate legal patient record. Participant 015 (015b) described this work process prior to the implementation of the wall-mounted and COW devices for electronic documentation:

> the culture of nursing at that time was, you'd do all your care and then document all your care with a cup of tea at the end of the day. That's not new – we all know that culture exists – it was the coffee break time at 14:30 and everyone would sit down with their piles of charts and document away. And what we implemented with wall-mounts and computers-on-wheels, and electronic documentation, was a completely different way of thinking [than the previous paper-based documentation process]. And it took away that lovely social little hub at the end of the day where you all sit down and document...in the backroom. (015b)

Documentation best-practices supported by the regulatory College, and further reinforced by the design of the EMR, dictated that patient documentation should occur at the point-of-care, and immediately following the care interaction with a patient. As a significant practice change for nurses on this unit, participant 022 recalled having to stress the importance of documenting "as soon after as possible" in the messaging and education provided to nurses:

> what we were promoting and educating was *"you do your care – you document"*…because certainly from a process standpoint, nurses tend to hang on to their information and then at the end of the day they all kind of get together at the nursing station, sit down, and document for the day. We used to talk about, "you're holding information hostage by doing this." So, the whole process change of imputing your information into a computer system, it now becomes available to anybody that has access to login and review data, in a very timely fashion. So this was a big thing to get them [nurses] to change their process – *give care; document – give care; document*. (022)

Although the *"give care; document"* (022) perspective was advocated and enforced by the clinical informatics department, nurses quickly discovered various workarounds to regress and realign toward their previous documentation behaviours (e.g., save all documentation, and document once per shift). This regression was observed by participant 015 who stated that shortly after the conclusion of the "honeymoon phase" (015b) of the wall-mounted and COW device implementation, the clinical informatics department witnessed a backslide toward pre-implementation work patterns and documentation behaviours. Nurses began returning to old work habits of saving their documentation to scraps of paper, and documenting at a later time during the shift, instead of immediately after the care instance. Regardless, the influence of the clinical informatics department and the wall-mounted/COW actors was clearly apparent in the workaround developed by the nurses. Instead of regression to the previous 14:00-15:00 documentation time period, nurses sought "an equilibrium" and their documentation practices only "slid back a bit – not back to 14:30" (015b). Instead, "people knew how to

jot down notes and document at 11:00" (015b). This subtle anti-program developed by nurses appeared to be both an effort to appease the clinical informatics department, but also a purposeful act to limit their usage of the wall-mounted/COW devices in favour of a preferred work pattern.

The nurses' anti-program against the "*give care; document*" mandate was also exacerbated by a host of technical issues possessed by the wall-mounted and COW devices. Since the wall-mounted and COW devices suffered from significant usability, functionality, and service quality issues, the devices' indispensability for the nursing role was never fully learned by or translated for the nurses. For instance, apathy toward the technical failure of the devices resonated during the implementation and highlighted the lack of nurse subscription to the wall-mounted and COW devices as indispensable:

> at the time, we talked a lot about that apathy and, I guess, burden to nursing, right. If you're working short…and you've got to skate through your day hoping you land on your feet at the end of it, to take time to say: "Oh, wow, that wall-mounted device is broken. I should do something about it." It's not even in there. (015)

One major actor that positioned the wall-mounted and COW devices as indispensable was the clinical informatics department. Since it was the clinical informatics department's role to implement the wall-mounted/COW devices and advocate for a "*give care; document*" work redesign, the nurses were cognizant that they had to at least minimally use the system to avoid repercussions or consequences related to the failure to document patient care. Although the nurses continued to use the devices to meet their basic documentation requirements, the nurses active anti-programs continued

to modify and refine the *"give care; document"* ideal espoused by the clinical informatics department:

> Oh it gets creative. They were jotting down notes on paper and then going to...a stationary device. They would still use the devices in the room that were on the wall even though they were propped up with lotion bottles – they would still use them – that's why they propped them. So they were at the right height so they could work. The COWs, as they died, they got put in to the corner and they'd use the one that was left [still functioning]. They modified their processes to what equipment was available to them – not unlike a blood-pressure cuff – and they would hoard – they'll hoard the blood-pressure cuffs because there are only two that work. They'll hoard a device so they have it available – that type of thing. They get very creative. (015b)

Since the nurses realized that some level of usage of the wall-mounted and COW devices was necessary to meet minimum requirements related to clinical documentation, the nurses selectively hoarded or modified various devices they preferred, and cast off others. In this way, the nurses were able to conform *enough* to the clinical informatics department's mandate to use the wall-mounted and COW devices, but also exercise anti-programs of apathy and work redesign refusal. For instance, the delayed charting behaviour described previously was not fully addressed until the clinical informatics department informed staff that the EMR system kept time logs of all access and documentation generation, and that they were able to identify clinicians who were not fulfilling the *"give care; document"* practice.

In this situation, indispensability was not demonstrated, learned, or represented by nurses during the initial implementations of these devices; rather, the wall-mounted and COW devices appeared to be extremely disposable and modifiable due to a number of socio-technical weaknesses in the actors' design and implementation into work culture. Regardless, with the increased reliance on electronic documentation, the wall-mounted and COW devices did (eventually) begin to represent as indispensable to nurses, due to the strength of other actors in the network (e.g., clinical informatics department, documentation requirements by the College, and "*give care; document*" inscription). Therefore, although the wall-mounted and COW devices in this situation eventually became indispensable for nurses, the jaded process of learning this indispensability likely reinforced a substantively different conceptualization of the technical actor than other examples previously discussed (i.e., Public Health Unit's Facebook page, and Urgent Care Care's FirstNet Tracking board).

Habituation

Over time, the use of the wall-mounted and COW devices became more integral to the work and documentation processes. As described by participant 022, the "*give care; document*" tenet ascribed to the wall-mounted and COW devices eventually stabilized and became enacted in the Complex-Continuing Care Unit over the five year post implementation period:

> [Use of the wall-mounts and COWs] was fairly functional – there was still the odd issue – but for the most part, they had become very adept [at using the wall-mounted and COW devices], and to call I.T…for appropriate support [when needed]. They just carried on. (022)

Subsequently, it would appear that the habits formed around the use of the devices had become solidified in clinical practice over the five year period and likely began to represent as a Blackbox network in everyday clinical action. The presence of this Blackbox developed over five years was acutely demonstrated when the wall-mounted computers on the Complex-Continuing Care Unit were downscaled in preparation for the implementation of a new, dual-purpose bedside patient-entertainment terminal that could also function as a clinician access point for the EMR system. The unit-wide implementation of the patient-entertainment terminal was proposed as a solution to the numerous access and technical issues of the previously discussed wall-mounted and COW devices. Unfortunately, this newly implemented patient-entertainment terminal also suffered from a massive array of social and technical issues that limited its immediate or long-term functionality and usefulness. For instance, the support arm affixing the patient-entertainment terminal to the bedside was extremely "bouncy" (022), which made data entry difficult. Similarly, the calibration of the touch screen was "way off, so [data entry] became an exercise in frustration for the staff" (022). Finally, since the terminal served a dual entertainment-clinical purpose, there would be specific instances over a clinical shift where a clinician would need to interrupt a patient using the entertainment features of the system:

> because it's a patient entertainment system *and* access into Meditech [the EMR], the patients are paying for the entertainment part, and as a staff you're coming in and saying "I have to stop you watching your movie while I do some documentation" – that really did not go over well. (022)

Further exacerbating the poor reception and implementation of patient-entertainment system implementation was the removal of all wall-mounted computers in the Complex-Continuing Care Unit. The removal of the wall-mounted devices was premised on the rationale that given the numerical increase of input devices, a reduction in wall-mounted devices could be justified (i.e., "the idea… [that] every patient has a computing system by the bedside" [022]). Similarly, it also was decided that all "COWs [on the unit] were [to be] no longer supported or replaced" (015b). The subsequent reaction by nurses who had grown accustomed to the wall-mounted computers (and had already developed a deep level of disdain toward the patient-entertainment terminals) was captured by participant 022:

> They [nurses] weren't happy – they weren't happy *[laughs]*! I think it did have an impact in terms of the availability of devices, whereas before they had become very good at *do the care, then document*. They tended to slide back into old habits of holding onto information, until they could get to a computer of their choosing, that did not involve being next to a patient. (022)

The implementation of the new patient-entertainment terminal and subsequent removal of the wall-mounted devices caused a retreat of previously established habits related to documentation and patient care. Similarly, the various habits related the *"give care; document"* practice approach began to slip since a key actor (i.e., wall-mounted device) had been abruptly removed from the nurses' actor-network.

Due to the regression in documentation habits, it would appear that the habits formed over time using the wall-mounted devices in specific patterns of action were largely Blackboxed, and the introduction of an inferior technological actor (i.e., patient-

entertainment terminal) caused significant disruption of the stabilized network. The extent of the Blackbox network dissolution was captured by participant 015 in her reflection of the immediate cessation of habits formed over the five years of using the wall-mounted and COW devices for electronic documentation:

> Point-of-care documentation stopped altogether, because they wouldn't use the bedside devices, so they were jamming in what they could at the desk [in the nursing station]. They were going back to their old practices, documenting everything at the end of the day. So, that was a huge dip in practice. (015b)

Although repairs and modifications were attempted to the patient-entertainment terminals, the Complex-Continuing Care Unit eventually necessitated reinstalling the wall-mounted and COW devices to satisfy the needs of the nurses who had become previously accustomed to their presence. Due to the subsequent "dip in practice" witnessed by participant 015, "trying to recoup" (015b) the previous habits and behaviours that had been formed prior to the implementation of the patient-entertainment terminals was attempted. Unfortunately, participant 015 claimed that the return to previous habits like point-of-care documentation and "*give care; document*" practices had been a "fairly slow shift back" (015b) after the patient-entertainment terminal implementation.

The habits formalized and stabilized after the implementation of the wall-mounted and COW devices appeared to have been severely compromised by the shifting actors in the network (e.g., removal of the wall-mounts, and inclusion of the patient-entertainment terminals). It would appear that the habits related to the "*give care; document*" practice that had been espoused and inscribed five years previously also suffered significantly,

with a noticeable retreat in documentation best practices. Therefore, the habituation of the "*give care; document*" inscription that had been labelled on devices like the wall-mounted and COW devices was only sustainable as long as those devices were present in the immediate actor-network. Upon their removal, the strength of the wall-mounted and COWs as actors reinforcing the learned habits of nurses (e.g., "*give care; document*") was demonstrated in the regression to previous work patterns and documentation practices.

Summary

Throughout this chapter, learning strategies were described and explored through case exemplars. As described throughout the exemplars, the strategies of indispensability, semblance, and habituation can be learned and acted upon by nurses and other human actors in a variety of ways. In some cases, these strategies were *a priori* placed upon social and technological actors by other powerful actors in the network in an attempt to inscribe a specific behaviour or action (e.g., "*give care; document*" inscription placed upon the wall-mounted and COW devices). Other times, these learning strategies were actively modified or refuted by nurses to the point where they became the precursors to anti-programs that attempted to translate new alternatives to the emerging network (e.g., modifying work patterns to avoid use of the wall-mounted and COW devices). In another case, the learning strategies and their interpretation by actors appeared to align sufficiently to expedite uptake and use of a technical actor within a larger actor-network (e.g., electronic tracking board). Subsequently, the strategies of indispensability, semblance, and habituation were exercised and used by nurses in

different ways and for different purposes, dependent on various network forces in the environment.

In the final chapter, the overall conclusions, implications, and recommendations stemming from the study findings of this study are presented. Concluding thoughts related to this dissertation as a stepping-stone to a larger program of study are also included.

Chapter 7 – Discussion, Implications, and Conclusions

In this final chapter I present a discussion of this dissertation as a larger body of work, and conclude with various implications, recommendations, and study limitations for consideration. The two research questions addressed in this study included: (a) how do nurses conceptualize health technology used in practice? and, (b) how do nurses learn about health technology used in practice? For the purposes of this dissertation, *technology* was described as a non-human entity underpinned by a computerized processor. Technology used in or for health-related purposes was denoted as *health technology*. Various data collection methods from a number of human and non-human actors helped identify different perspectives about *how* nurses conceptualized and learned health technology. In the following sections, a discussion of the study findings is provided, along with implications and recommendations, study limitations, and concluding thoughts.

Key Findings and Discussion

Technology Conceptualization by Nurses

The findings of this study provide insight into nurses' conceptions of technology as used in practice. Three thematic projections emerged from this study. First, nurses typically positioned themselves as the *user* of technology and were able to describe and identify meaningful technical actors in their larger networks. Second, nurses used a variety of conceptual and philosophical approaches to describe what technology was, and how these non-human actors operated in their environments. Third, nurses consistently projected the theme of *action* or *praxis* onto their interaction or use of technology.

The positioning of human actors (e.g., nurses) in relation to technical actors was an interesting finding. Nurses were cognizant of the way they outlined their relationship with technology by highlighting features in relation to their work environment or the way other experiences in their daily life influenced their understanding of technology. This blending and blurring of environments and apparent transference of knowledge and skills from practice environments to personal life (and vice versa) was uncovered in the participants' categorization of described technology. The listings of various technologies provided by participants provided an insight into what present day nurses deemed to be *health technology*, and also elucidated a number of nuances of naming and identification strategies currently in operation. From the findings of this study, it is clear that nurses did not describe or identify technology as a monolithic entity; rather, nurses commonly defined technology by describing their positionality when using a form of technology, and by conceptualizing technology's role from within practice.

The ability of nurses to describe finer elements of technology used in practice was also highlighted in a number of the participants' use of conceptual and philosophical perspectives to describe their relationship with technical actors. Unlike the technological conceptualization themes published by authors like Barnard (1996; 1997) and Sandelowski (1997a; 1999) in the late 1990s, the current conceptions of technology by nurses in this study appear to be more balanced and cognizant of sociomaterial considerations. None of the human participants interviewed or accessed in this study provided conceptions that were strongly analogous to technical romanticist or optimist ideals. If anything, nurses' conceptualizations of technology used for practice appear to be influenced by factors originating from outside the profession. For instance, in the

majority of interviews conducted with nurses, descriptions and discussions of social technologies or technology used for personal purposes emerged and became central to the dialogue. In a few extreme cases, nurses stated that they saw little difference between technologies used for personal purposes and health purposes. In these cases, health technology was a technical actor that could be used for a health purpose, and did not necessitate being physically located in a traditional healthcare related environment (e.g., hospital).

Finally, the action or praxis elements of technology described by nurses were similar to other examinations of technology used in practice (Munck, Fridlund, & Mårtensson, 2011; Wikström, Cederborg, & Johanson, 2007). The conceptions and definitions of technology have long possessed an affinity toward describing various action and movement oriented phenomena (Barnard, 1996). Nurses interviewed in this study also endorsed the appreciation that technology was an actor that allowed an individual to change or modify some element of the immediate environment. A number of participants described how technology enabled them to complete an action (or set of actions) within a health context. Conversely, action that is sometimes facilitated (or enabled) by technology was not always deemed to be positive or warranted. Nurses did not always view technology as a positive actor in the generation of action; instead, it was an actor that needed to be negotiated within the network of other sociomaterial actors. In this respect, technology was not always conceptualized as a positive entity for healthcare purposes. Technology was constantly and consistently subject to a dynamic array of forces that were initiated by other actors in the immediate (and proximal) networks, and the resulting changes modified the technical actor's value to the presenting context.

Similarly, technology used for health purposes is not static; rather, health technology actors are dynamic and evolve depending on context and the needs of other actors in their proximity. Given the increased blurring of personal and professional lives through the use of Internet and mobile technologies, nurses do not seem to need to fix their conceptualizations of health technology to either a specific actor or environment. Evidence of this broadening view of health technology was observed in nurses' active use and endorsement of non-traditional technology (e.g., iPhone and social media) for clinical purposes. Unfortunately, much of the messaging related to health technology (e.g., *Infoway*, 2006; 2011) has continued to focus on conceptualizing end-users (e.g., nurses) as adversarial actors who require mobilization to adopt and use technology. The findings of this study demonstrated that nurses are actively adopting, modifying, translating, and using technology for health purposes. Regardless, it is appreciated that the processes and methods that some nurses use to learn and adopt technology (e.g., anti-programs) may not be compatible with usage inscriptions presented by organizations like *Infoway*. If anything, the findings of this study offer insight for organizations like *Infoway* who are interested in generating increased and deeper levels of clinician adoption and use of technology. Firstly, the positionality of nurses in relation to technological actors needs to be taken into account when exploring and mandating why nurses should adopt and use technology. To date, much of the scholarly literature that examines nurses' use of technology has ignored this extremely important sociomaterial attribute. Secondly, it may be worthwhile for health organizations to recast their perspectives of end-user adoption in light of nurses' current conceptualizations of health technology in 2013. Health technology no longer presents as a monolithic entity to nurses; rather, it is viewed

and conceptualized as a dynamic tool that is modifiable by nurses and other actors in the environment.

Further evidence of the importance of sociomaterial considerations in relation to nurse adoption of technology has been recently noted by Cross and MacDonald (2013). In Cross and MacDonald's (2013) grounded theory study, they examined the range of emotions and reactions by nurses' toward the integration of computer and electronic health record technology into clinical practice. Their study findings outlined a range of important factors that facilitate the adoption of computer technology in clinical environments. Included in their findings was a dynamic array of socio-cultural-technical considerations (e.g., organizational and professional discourse, past experiences, biomedical technology, etc.) active in the nurses' environments that facilitated the potential for technology adoption. Over this process of developing a relationship with the technology, nurses individually made the decision to "adopt, adapt to, or ignore" (p. 129) the computerized technology.

Learning: Process and Product

A specific finding that emerged from this study was the dynamic interplay between the *process* and *product* elements of learning technology. The process of learning technology was a dynamic action operationalized by nurses in two ways: informal and formal learning (Marsick & Watkin, 2001). Informal learning was a preferred method of continued learning once a baseline knowledge or competency with the technology had been acquired. Formalized approaches to learning technology were generally not viewed as valuable methods to learn nuanced or deeper level competencies

of a specific system. Examples presented of formal learning related to technology use were typically found to be ill-suited for learner engagement and customization, especially in relation to new systems used in academia or practice. A few nurses commented that the formalized training sessions for specific technology were not valuable and they would rather utilize various self-sponsored informal approaches for future learning. Nurses in this study also appeared to use informal approaches to learning technology when they required specific knowledge related to using a system in practice. Given the previous finding related to the action-praxis conceptualization of technology, it is not surprising that the findings in this study highlighted nurses' affinity for a *just-in-time* learning approach. Since technology engenders an action-praxis response by nurses (e.g., nurses are using technology to do something), it is likely that clinicians preferred to seek a source of learning that was more spontaneous, and dependent on emergent needs arising from the practice setting.

The preference for an informal learning typology has also been found in other texts that come from management sciences literature. For instance, Pisano, Bohmer, and Edmonson (2001) found that "learning-by-doing" (p. 766) through cumulative experiences played an important role in the adoption of minimally invasive surgical technology used by surgical staff at 16 different organizations with more than 660 surgeries. This learning-by-doing process was heavily influenced by social factors in the immediate environment, including the stability of the surgical team, and how knowledge of the procedure was captured and translated over time. Further evidence of the benefits of unstructured learning was uncovered by Schilling, Vidal, and Ployhart (2003) who studied teams of people solving complex problems. Schilling et al. (2003) found that

participant groups who worked on varied, heterogeneous problems were able to learn significantly faster than those who had been assigned specific problems that lacked variation. The authors purport that task variation enhanced learning through a process of "deeper cognitive structures or through simulating insightful synthesis between different problem domains" (p. 52). Like the findings in the current study, nurses typically preferred to learn technology through informal modes, while in practice, and stimulated by a range of heterogeneous problems encountered in the moment. Training sessions that lacked variation or real-life applicability (e.g., formalized EMR training sessions) were typically not valued as meaningful learning opportunities.

Emerging alongside various procedural elements, products of learning technology were also outlined by nurses. The *learning product* commonly was made visible upon deconstruction of an actor-network of practice where a technology had become an important actor in the construction of the network. Therefore, products of learning technology were iterated and demonstrated by nurses in the various reactions, conceptualizations, and positionings of technology they described as influential to their practice. Also, learning products were typically more complex than mere competencies related to the use of technology; rather, these products of learning described how a technology was modified (either in terms of conceptualization or physical changes) to act or operate in different roles or in new environments. As outlined by numerous researchers from a variety of disciplines, *how* a technology is used (i.e., product of learning) may vastly differ from the developers' original plans or other actors in the environment sponsoring its use (Coiera, 2004; Harrison, Koppel, & Bar-Lev, 2007; Orlikowski, 1996). In this way, by exploring the learning of nurses, a deeper and more

nuanced of understanding of how nurses *use* technology was acquired. A few key insights can be drawn from this realization. First, learning technology is an ongoing action within nursing practice that appears to shape how technology is used. Similarly, the process of learning technology does not necessarily end with the technology being used as originally conceptualized or prescribed by other actors within the network. Through the translation process, network actors of importance define and shape how the technological actor will be conceptualized and enacted over time. For example, some nurses in the study developed a range of workarounds to either reinforce the technology's value (e.g., iPhone use in clinical practice), or devalue its existence (e.g., COW abandonment in the Complex-Continuing Care Unit). Therefore, at no one period of this ongoing process should technology use be seen as a static product or end result. Conversely the products of learning that resemble nurses using a technology only exist as long as a stable actor-network (or Blackbox) remains to enforce the roles and alignment of the actors. Most of the current technology adoption and use models (Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003) do not include *learning* (past or present) as an element that influences how nurses and clinicians use technical actors in practice. The findings of the current study suggest that exploring the nuanced process (and products) of nurses learning technology offers a deeper understanding of current and potentially future technology use. Therefore, it is proposed that the actions undertaken during the learning of technology may represent as a proxy to study the use of technology by nurses in practice. Exploring how nurses learn technical actors may also offer a useful complement to traditional technology evaluation frameworks that are much less reactive or receptive to sociomaterial considerations.

Strategies of Learning

Although clear distinctions between the processes and products of learning health technology were uncovered in this work, these divisions became cloudy when exploring a multitude of actors undergoing translation simultaneously. For example, the nurses in the Public Health Unit needed to learn how to recast previous personal experiences with Facebook into a tool used for health promotion. As demonstrated in this example, the nurses were able to use various informal methods to learn how to effectively distribute a health promotion message via the Facebook platform. Subsequently, the Facebook platform eventually transitioned into a learning product when it became endorsed (by the nurses and senior leadership, and also the consumers) as a health promotion tool that would be supported permanently by the department. Although clear distinction of *when* the nurses' learning transitioned from process to product is unclear, the blurring actions of these two approaches resulted in the generation of an inscript, affixed to the technology or related artifact being learned. Finally, in order to assist the inscription process, nurses used three distinct strategies implemented during the learning of technology: indispensability, semblance, and habituation.

These three strategies contained both process and product elements of learning, and also were inscribed onto a number of different technological actors across varied environments and contexts. Unlike past conceptualizations of technology use that tended to regard technical actors as monolithic entities found in practice settings (e.g., *Infoway*, 2006), the strategies used by nurses (and their resulting inscriptions) suggest a more balanced socio-technical relationship between humans and technology. For instance, the strategy of indispensability contained both process and product learning elements,

operationalized by human actors through a balancing of social and technical considerations. In the Urgent Care Centre example, the indispensability of the tracking board was reinforced and negotiated by both social (i.e., nurses, and registration clerk) and material (i.e., manual tracking board, and electronic tracking board) actors in the immediate environment. Nurses exercised the strategy of indispensability through the process of using the tracking board, but also by developing new roles and methods to stress the importance of the tracking board actor in daily workflows.

Unlike the tracking board example, the wall-mounted and computer-on-wheels (COW) implementation did not experience the same levels of subscription to the indispensability strategy in relation to the technical actors, or the work processes they endorsed. Although the wall-mounted and COW devices were eventually recognized by nurses as *indispensable* to their clinical roles, the process and products of learning required to achieve this realization required more time and the explicit advocacy of other powerful actors (i.e., clinical informatics department) from the larger network. As found by Darbyshire (2004) in his examination of a poorly developed and implemented clinical patient information system (CPIS), nurses were not convinced of the system's indispensability in work processes. Subsequently, nurses in Darbyshire's (2004) study inscribed various negative perspectives onto the CPIS including ideations related to the system's limited benefit to both patient care and the nursing role. Nurses begrudgingly recognized that the mandated "CPIS had significant impact and influence on their practice" (p. 19) and used the system while continuing to voice comments related to the system's inappropriate nature. A similar response was found in one of the case exemplars noted in the current study (i.e., wall-mounted and COW device

implementation in the Complex-Continuing Care Unit). Even though nurses did not immediately view the wall-mounted and COW devices as indispensable, some level of usage of the technological actor still occurred. In the wall-mounted/COW device example, the legal implications of documentation along with other supporting proximal actors in the network (i.e., clinical informatics department) reinforced the importance of using the technical actor to the point where absolute refusal was not an option; rather, subtle anti-programs of actions were instituted by various actors to (re)develop a mutually agreeable indispensability inscription.

Timmons (2003) used the term *resistive compliance* to describe the above phenomenon of nurses using a technology while also being dismissive of its role in practice. Although Timmons used the term *resistance* to denote the actions of nurses in his study, the findings of the current study challenge the term *resistance* in the learning and use of technological actors by nurses. Nurses are *not* resistant to learning and using technology; instead, nurses' inscriptions affixed to certain technologies and artifacts sometimes differ from other actors in the network who support another interpretation or inscription of the technology. Therefore, it is important to recognize the differences in actors' interpretations and inscriptions of technological actors in a larger network. *Resistance* to follow an inscription presented or advocated by another group of actors could be viewed as an opportunity to deconstruct the actions and interests of the actors generating the opposition. Through this sort of socio-technical analysis, a mutually negotiated approach could be sought during the development and implementation of technology in environments where nurses practice. If anything, the findings of this study recast the perspective of end-user resistance as a proactive feature exercised by nurses

(and other human actors) to protect a stabilized actor-network from a potentially unstable, foreign technical actor. When viewing technology refusal from this perspective, the importance of recognizing and appreciating the agency of both human and technical actors in a given environment is made explicit.

There are other instances when actions that initially appear as resistance to technology, are revealed as responses to other factors, upon further study. For example, in Greenhalgh and Stones' (2010) examination of nurses using personal digital assistants (PDAs) in homecare, they found a range of use patterns related to the handheld device. Some nurses used the PDA as inscribed by their employer, while others actively modified their use of the technology to suit their practice needs (e.g., using Google Maps to help with navigation). Nurses who did not use the PDA typically did so because of difficulties learning the device, or, they felt that the system undermined some social element of nursing work. Instead of branding these end-users as resistive, Greenhalgh and Stones dug deeper into the situation and found that some of the non-users "had been alarmed by the opening screen on the [PDA], which displayed the word 'STOP' and demanded to know whether the nurse had a 'legitimate relationship' with the patient before revealing the record" (p. 1292). Due to a recent high profile health information breach that was publicized in the media, inscripts questioning the nurses' relationship with patients were pre-programmed into the functionality of the PDA each time a nurse attempted to access patient information. Due to this "authority and the threat of surveillance" from abroad, powerful inscriptions setting the "preconditions for non-use of the [PDA]" (p.1292) were enacted, which influenced some of the nurses in their usage of the device. Therefore, *resistance* to using the PDA in this case was, in fact, nurses attempting to avoid the

disruption of a functional actor-network due to the introduction of a questionable technical actor.

Semblance was another strategy that emerged from the findings of the study. Semblance was typically related to a specific technical actor (or its processes) that was found to possess some level of transference between disparate environments. In this way, semblance allowed human actors to take previous learning about technology from one context, and translate this knowledge of the technical actor into a new or different environment.

The strategy of semblance was demonstrated repeatedly in the findings, including by elements related to the transference of basic technical competencies across contexts, and by the uniformity of certain technological actors across time and space. Consequently, semblance was revealed as a dynamic learning strategy that impacted nurses in a variety of ways. Firstly, the semblance of new technologies to old technologies resulted in easier and quicker learning. For example, nurses found that using an electronic tracking board that highly resembled its manual predecessor assisted in the learning and uptake of the device. Secondly, the strategy of semblance was also evident when certain technological actors moved from one context into another where its presence and use had not been previously recognized or endorsed. In the case of the clinical nurse specialist using Twitter, this nurse was able to translate her previous knowledge and use of a social technology from a personal context into her professional role as an advanced practice nurse. Similarly to the clinical nurse specialist's semblance using Twitter, a group of public health nurses were able to translate their previous knowledge of Facebook into a functional health promotion tool for clients. Although the

Facebook platform required modifications to operate in this new context (e.g., development of new policies to guide clinician interaction with clients), there was enough semblance of the actor (and its larger network) that repurposing the technology into a health promotion context was possible with minimal effort. Orlikowski and Gash (1994) have also alluded to elements related to the strategy of semblance in their previous work examining assumptions, expectations, and knowledge of technology:

> people tend to approach the new in terms of the old. The same may be expected of people confronting new technology. In the absence of other information, they will attempt to interpret it in terms of their existing technological frames, imposing assumptions, knowledge, and expectations about a familiar technology on the unfamiliar one. (p. 191)

As semblance appears to be an effective and potentially important learning strategy, further research on understanding and incorporating semblance would be productive. Such efforts are supported by Straub (2009), who proposed that since the majority of the literature about technology had only examined *learning* within work environments, a broader conception was required to capture the "bleed-over [and] merging [of] personal and work lives" (p. 643). He advocates that since "technology has infiltrated far deeper into everyday life than just formal professions…investigation is needed into the various processes that influence and regulate informal adoption [and learning] of technology" (p. 643). As noted in this dissertation, the strategy of semblance appeared to operate at the fringes of environments and networks, and encouraged human actors to translate their previous knowledge of technology into new and different contexts. Therefore, further

exploration of the reaches and impact of this learning strategy within nursing populations using health technology should be considered.

Habituation was the last strategy that emerged from the findings of this research study. Habituation was an approach to learning that possessed noticeable elements related to the process and products of learning technology, and was typically a temporal strategy exercised by nurses. For instance, the wall-mounted and COW devices in the Complex-Continuing Care Unit exemplar demonstrated how actions exercised by human actors can become unconscious and automatic over time. As described in the case exemplar, the nurses' habitual actions of using the wall-mounted and COW devices eventually became Blackboxed over time to the extent that the function, presence, and role of these devices went largely unquestioned. With the implementation of a new patient-entertainment terminal (and subsequent removal of the wall-mounted devices), the previously established Blackbox network underpinning electronic documentation was severely compromised. Through the dissolution of the established Blackbox, the actions that had been learned, reinforced, and habitualized by various human actors (e.g., nurses) related to the wall-mounted/COW devices were quickly abandoned. All habits that had been formalized over time in relation to the wall-mounted and COW devices were only able to exist as long as the actor reinforcing the inscription remained present in the larger network. Jasperson, Carter, and Zmud (2005) hypothesized that behaviours using technology become habitualized over time, "unless interventions occur to disrupt the formation of these deep, non-reflective mental scripts" (p. 535). As technology is further learned and becomes engrained into practice, many actions "which an individual engages in [turn into] a recurring pattern of using a selected subset of technology features in

his/her work" (p. 535). The introduction of the patient-entertainment terminals was an intervention that disrupted the perpetuation of the inscripts related to habituation that were firmly implanted on the wall-mounts devices. Further evidence of habituation comes from a recent meta-analysis conducted by El-Khatib and Barki (2012). They found that actions and activities that are performed frequently and require low cognitive effort are highly correlated with intention to use a system. Since the patient-entertainment terminal was replete with technical issues preventing nurses from performing actions frequently or with low cognitive effort, habituation of new behaviours was not able to occur.

Overall, the various strategies exercised by nurses learning technology should be used as conceptual *starting points* from which to plan, develop, implement, and evaluate new health technology. Since learning is a process that influences elements of a technological actor, focusing on how humans learn technology as part of the development and implementation process of new health technology may be a useful strategy to assist with the creation of robust systems. Since end-users like nurses and clinicians will only use (and continue to use) a technological actor if certain networks of action are developed and sustained, reflecting on strategies and inscriptions that drive nurses to learn health technology may be worthy of consideration. Similarly, evaluation of technology and its use could benefit from exploring how the strategies of indispensability, semblance, and habituation are operationalized in larger actor-networks. As outlined previously, evaluation espoused by organizations like *Infoway* (Lau, Hagens, & Muttitt, 2007) has historically focused on techno-centric elements of determining the benefits of using a technology system. The strategies used by nurses uncovered in this study reinforce the

importance of evaluating of technology from a sociomaterial perspective, in order to better realize and understand the impacts a technological actor generates within an actor-network.

Implications and Recommendations: Practice and Education

The findings of this study provide important implications for professional development in practice settings. As explored throughout the findings, nurses found formalized approaches to learning technology to be at times lacking usefulness or sensitivity to individual learning needs. Although it is understood that formalized training sessions are typically more cost and time effective for large organizations undergoing technological implementations, the findings from the current research study suggest that they should be used as a part of a larger, and strategic educational initiative. The receptivity of organizations toward endorsing various informal learning opportunities should be sought and further explored as it was apparent that this modality of education was both commonplace and valued by nurses.

The emergence of strategies related to learning technology has implications for future practice and the development of health technology. *Infoway*'s (2011) current reflections in regards to support for clinician adoption of health information systems include the development of clinician value propositions and the determination of how to best train a heterogeneous clinical workforce. One finding from this study that may assist in addressing some of *Infoway*'s concerns would be to sensitize technology developers, researchers, and policy makers to the importance of recognizing how nurses inscribe meaning to technological actors used in practice. The learning strategies of

indispensability, semblance, and habituation may provide some useful theoretical (and pragmatic) approaches for consideration in this regard. For instance, further exploration of how indispensability is actualized in diverse clinical environments could provide insights as to the mechanisms required to sustain the adoption of a technological actor in a longitudinal fashion. Since clinicians will only continue to use a technological actor if it is deemed to be indispensable for their role, gaining a deeper appreciation of the complexion and nuances of this learning strategy are important for future end-user adoption projects. Similarly, the strategies of semblance and habituation also provide important theoretical and pragmatic suggestions for technology development and implementation projects. The strategy of semblance reinforces and complements the findings of other researchers who have explored how a new technological actor (e.g., bar-code medication administration, and computerized provider order entry) can disrupt established clinical workflows in unpredictable fashions (Novak, Holden, Anders, Hong, & Karsh, in press; Campbell, Guappone, Sittig, Dykstra, & Ash, 2009; Shabot, 2004). Regardless, the study findings also highlighted examples (e.g., tracking board in the Urgent Care Centre) where the technical actor was used by nurses to *reinforce* a preferred work process and other social attributes of the nursing profession (e.g., bed management, and documentation at the nursing stations). Therefore, it may be worthwhile to explore the strategy of semblance to determine if it is a viable mechanism to gauge if a technological actor will align with nurses' preexisting work patterns or professional preferences.

Finally, habituation has the potential to be an important factor for future consideration in terms of technology adoption and use. The study findings suggest that

the past experiences and learning of technology can become habitualized into unquestioned mental schemas held by nurses. This mental schema is then translated and applied to future learning of technology, at times with disastrous effects. Therefore, in order to generate improved future levels of technology adoption, care and consideration of nurses' past learning and interactions with technology must be addressed, as it would appear that these previous experiences can be significant in the future use of a technical actor.

Along with various professional practice and policy implications, the findings of this dissertation also have direct implications for nursing education and curriculum development. First, the notion of health technology should be expanded to include larger and more inclusive ideals related to the use of a technical actor(s) in the maintenance and management of health(care). Health technology should be conceptualized as being an actor that exists where the patient or client exists, and not as a geographically isolated entity found in specific clinical environments (e.g., acute care hospital). This broadened perspective of health technology provides a range of implications for the current iteration of nursing education. Informatics or technology related concepts have typically been delivered in isolation from other traditionally espoused nursing curricula. Historically, nursing educators exploring topics including nursing theory, scholarship, and professional practice have tended to avoid discussion of informatics and health technology (Kleib, Zimka, & Olson, 2013; Nagle & Clark, 2002; Nagle, 2007; Nagle, 2013). As noted in the findings, health technology is a dynamic construct that currently influences various elements of work and life. Thus, nursing curricula should be

expanded to appreciate the non-static nature of health technology, and the potential benefits (or consequences) that may arise from its use within education settings.

Like conceptions of technology, the learning of technical actors also needs to be addressed in nursing education. While learning and mastering basic technical competencies related to specific technology is still important (e.g., proper setup of an intravenous pump), future nursing graduates will require the ability to learn, relearn, and transition their previous technological knowledge into new and dynamic environments. Given the quick obsolescence of certain technological systems, a focus purely on skills based approaches to learning health technology is likely of limited value moving into the future; instead, providing students with the opportunity to demonstrate and operationalize the different elements of technology use will be required. For instance, students should be provided the opportunity to exercise their conceptions of health technology in a more formative fashion in undergraduate curricula. Currently, technology in undergraduate education has been aligned with educationally focused tools (e.g., learning management systems, or high fidelity simulation mannequins). Students are sometimes not afforded the opportunity to translate their ideas of technology use from educational settings, to those where a health(care) focus is required. Similarly, students often possess a wide range of pre-developed competencies with technology (e.g., Web 2.0 and social networking knowledge) (Skiba, Connors, & Jeffries, 2008), but are not provided the context or environment to demonstrate or evolve these skills in health care settings (e.g., banning of cellular devices, prohibition of laptops in class, or other messaging inscriptions that demote the value of technology in education). As outlined in the study findings, nurses are actively repurposing various technologies for both health and

education purposes. If students are provided an environment in which to grow and build upon their previous knowledge of all forms of technology, an improvement in the culture and receptivity of informatics may be fostered by educational settings.

Moreover, the use of health technology within education should also be reframed as a mechanism to assist learning and content synthesis. Currently, nurses in this study used technology in various facets of their work and life to help translate information and knowledge. Although not explicitly studied here, the role technology can play in learning, organization, and translation of knowledge required for professional practice is a fruitful area for future consideration.

Another implication arising from this study is the need to appreciate that the process and products of learning health technology should not be viewed as static competencies. As recently outlined in the CASN-*Infoway* (2012) entry to practice nursing informatics competencies, it is now an expectation that students enter an undergraduate program with pre-developed skills related to device and application use. Subsequently, students should be afforded the opportunity to evolve this pre-developed knowledge through opportunities embedded throughout curricula. Students need to be offered a curriculum that enables both formative opportunities to undertake learning in the form of process, and to experience and interact with learning products. It is recommended that at minimum students be afforded the opportunity to explore and critique health technology through the lens of traditional nursing theory, deconstruct the use of mobile technologies within clinical practice, and reconceptualize the growing importance of social and web technologies for professional practice and advocacy. Along with practice-focused implications, undergraduate students should also be offered

the opportunity to critically analyze their own personal-technical relationships, which includes their digital presence online and their understandings of technology as used for professional purposes. Over the last few years there has been a growing appreciation that an online persona is increasingly important to an impression of an individual's characteristics, personality, or attitudes (Cain & Romanelli, 2009). Therefore, students should be provided with an education that attempts to guide students toward safe, ethical, and professional use of these systems.

In graduate education, students should have opportunities to work on interprofessional development teams that build prototype health technology so they can become sensitized to the growing importance of socio-technical perspectives while designing, implementing, and evaluating technical systems used in healthcare. In this way, students of all levels will have the opportunity to expand their conceptualization of what is considered *health technology*, and potentially, stimulate new methods of practice into the future.

The final implication stemming from the findings of this research study is the need to continue research that examines nurses' learning and use of technology for practice. The use of sociomaterial interpretations of nurse-technology interaction offer a number of fruitful directions for future research that need to be explored: (a) how nurses *use* technology should be examined systematically, taking into consideration various strategies exercised by nurses during the usage process; (b) certain models of technology evaluation (e.g., UTAUT, TAM) should be reconsidered in light of the study findings, or made more sensitive to the nuances of nursing and healthcare work.

Implications and Recommendations: Theoretical and methodological perspectives

Since this study is one of the first uses of Actor-Network Theory (ANT) in the nursing literature, the methodological implications stemming from this study are important for future consideration. ANT provides the space for both human and non-human actors to exist, and be treated with equality in an analytical space. ANT allows the role of non-human actors to be recognized and appreciated as part of the larger sociomaterial fabric where action occurs. For the purposes of this dissertation, ANT served as the overarching lens driving elements of the data collection, interpretation, and findings.

This dissertation also generated methodological considerations related to ANT. As outlined in Chapter 3, Gad and Bruu Jensen (2009) state, "ANT is certainly not a method telling the researcher what to do" (p. 75). Unlike other theoretical approaches that are intimately connected to a research method (e.g., Grounded Theory), the use of ANT alongside a traditional data analysis technique also offered a unique opportunity to explore the functionality of this merger. In this study, Corbin and Strauss' (2008) interpretation of theoretical sampling and the constant comparative technique were both used through the lens of ANT. This hybrid of constant comparative technique and the overarching lens of ANT did become a valuable theoretical process for future consideration by nursing researchers.

Historically, ANT has been a research lens used to deconstruct specific actor-networks in confined or enclosed contexts. For the purposes of this study, it was hoped that through disparate examinations of nurses using technology, more encompassing

theoretical themes related to the nurse-technology could be developed. Consequently, data collection was not limited to an immediate context or environment; rather, a wide repertoire of human actors was sought in a variety of clinical and practice areas. Due to this structure, theoretical sampling was required to drive the data collection element of the study. In other examinations that use ANT, sampling techniques are rarely described, making this study potentially a unique example within the literature.

The use of ANT together with the data analysis strategy, the constant comparative technique, was an important evolution of the theoretical lens. Although many researchers using ANT do not describe their data analysis technique, it is suggested that the constant comparative technique is compatible with the theoretical lens of ANT. Since the goal of ANT is to trace networks of action through translational processes, the use of the constant comparative technique offers a functional and efficient mechanism to synthesize and reduce large amounts of data into interpretable thematic representations. One limitation of ANT is its ability to lead a researcher on a never-ending quest for actors involved in the process of network translation. As outlined by Lower (2006), one of the most difficult aspects of using ANT effectively is "decid[ing] where to draw the boundaries of an actor-network, especially as there are often several alterative actor-networks, which are still connected to each other" (p. 109). The constant comparative technique does not directly address this expansive nature of ANT's conceptualization; instead, the constant comparative technique was beneficial in refining the researcher's focus by forcing the process of open and axial coding. Through the iterative coding process, thematic categories are developed that help to reorient the focus of the researcher toward emergent

themes and dynamic inscriptions within the present data, rather than seeking a never ending cross-section of alternative actors and networks for interpretation.

Finally, the use of ANT as the theoretical perspective for studying how nurses conceptualize and learn about health technology provided a unique opportunity to explore the sociomaterial relationships that occur. Since ANT provides a vocabulary to describe nurse-technology interaction that is free of determinism, the extension of this theoretical lens in nursing for future research and exploration should be considered. Therefore, ANT is proposed as a readily usable option in line with other theoretical perspectives that attempt to represent complex systems and how agents (or actors) in these environments interact in dynamic and unpredictable ways.

Limitations

As with all research, there are recognized limitations to this investigation. The population of nurses accessed for this dissertation was driven by theoretical sampling procedures (and also latterly driven by Actor-Network Theory considerations), which may have minimized the opportunity for inclusion of other groups of human and non-human actors. The difficulty of both accessing and interpreting various actors across a multitude of disparate environments was also a study limitation. Unlike other ANT-inspired examinations, which are typically situated in one geographical area (or actor-network), this study relied on a wide sampling of human and non-human actors. The wide sampling of actors (especially in the early phases of sampling) may have resulted in important networks being missed or not being recognized as worthy of study.

Another limitation of this study was the difficulty in finding human actors who were critical or negative about their use of technology. Although the findings of the study were far from uniformly positive toward the role of technology actors in practice, the balance between the two perspectives was not overtly pursued. This imbalance in participation was noted throughout the analysis; most nurses and other human actors were critical of technology at some time, but as a whole, typically perceived technological actors in a positive light.

There were also limitations in some elements of the case exemplars used to help accentuate the learning strategies found in this study. At times, data from only a few principle participants or actors were available to describe and highlight a multi-year experience. Although archival materials were sought out, due to certain privacy implications and the length of time that elapsed since the event in question occurred, documents or humans involved in the process were sometimes not available for immediate consultation.

Finally, the lens of ANT did present as a limitation at times throughout the study. Due to ANT's requirement to treat all actors with uniformity during analysis, attempting to describe a specific actor's (i.e., a nurse) learning of another actor (i.e., health technology) became cumbersome on occasion from a linguistic perspective. As previously outlined by both Orlikowski and Scott (2008) and Sandelowski (1997b), English language customs make description and explanation of sociomaterial interactions difficult. Due to this inherent complexity, human actors may have been afforded more semantic privilege within the analysis (versus non-human actors) at times to assist the clarity and interpretation of the findings for potential readers.

Conclusions

Conceptualizations and learning of technology by nurses were explored in this dissertation, and as a whole the findings of this study shed light on an extremely complex sociomaterial dynamic that has been rarely questioned in the nursing profession. Although the findings are far from generalizable, they do afford scholars and practitioners some potentially fruitful directions for future research and practice. As outlined in this study, the use of technology by nurses is typically influenced by both conceptual perspectives and learned features of the technical actor(s). Viewing the *use* of health technology by nurses as merely a dichotomous variable (i.e., used or not used) devalues the entire sociomaterial context in which the usage occurred. Further, nurses seem to possess a much broader conceptualization of *what is health technology* in comparison to historical reports found in the literature from the late 1990s and early 2000s. Nurses participating in this study did not align with socially or technologically deterministic perspectives that were present in the nursing literature a decade ago. If anything, the findings of this study reinforce that technology used in the profession is extremely dynamic, and methods of description and evaluation that were once (potentially) valid need to be carefully reviewed to ensure they still endorse current perspectives and actions.

Finally, the findings of this dissertation reiterate the usefulness of exploring the process and products of learning from a larger, networked perspective. As described above, currently many evaluation methods used to deconstruct clinician use of technology fail to appreciate many of the sociomaterial nuances described by the findings of this work. As researchers and educators, it behooves the profession as a whole to

become more involved in utilizing teaching and evaluation perspectives that both appreciate and endorse the blurring of actors in sociomaterial experiences. Since all nursing practice and education occurs within a complex network of other actors, using research and teaching perspectives that appreciate this wider ontological perspective may offer a fresh and unique lens through which to address other issues in the profession.

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Appendix A: Letter of Information to Participants

Letter of Information:

Nurses' Learning and Conceptualization of Technology used in Practice

Date:
Dear Colleague,
I am a doctoral student in the Arthur Labatt Family School of Nursing, The University of Western Ontario. I am conducting a research study to generate insights about nurses' learning and conceptualization of health technology used in practice. To do this, I am seeking volunteers to participate in interviews related to technology use within nursing. I would like to invite you to participate in this study.

If you choose to participate in this study, I will arrange to meet with you at your convenience, and at a location of your choice, to interview you regarding your experiences using health technology in your practice. The interview will last approximately one to two hours and will be recorded and transcribed into a written format.

To ensure your anonymity, no names or identifying information will be included on the transcripts, nor in the analyzed data, or manuscripts. A code-number will be used to identify your data, but this code-number will not be shared with anyone else. All information collected during the interview will be encrypted (256-bit AES) and/or stored in locked filing cabinets for seven years after the study completion. At that time, all files pertaining to this study will be destroyed. When the results of this study are published, your name, any information disclosing your identity or that of your organization will not be released or published.

If you choose to participate, you can refuse to answer any questions or withdraw from the study at anytime. There are no foreseeable risks or discomforts associated with this study. Your contribution to the study may be personally rewarding knowing that you are contributing to better understanding health technology used in practice.
If you have any questions concerning this research study, please feel free to contact me, Richard Booth, at user@email.com or my thesis supervisors listed below. If you have any questions about your rights as a research participant, or the conduct of this study, you may contact the Director of the Office of Research Ethics at The University of Western Ontario at (xxx) xxx-xxxx, or, user@email.com. Please retain a copy of this letter for your records.

Sincerely,

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Appendix B: Interview Guide

Introduction:

I would like to thank you for participating in this interview to explore how nurses learn and use technology.

Today I plan to explore with you how you have learned about technology in your nursing practice. I'm interested to hear how you have learned about technology used in your practice – both from an individual perspective, but also in terms of the environment and context around you that affected your learning.

Before we begin, do you have any questions pertaining to the study?

Ensure participant has signed consent form
Restate permission to tape the interview

1. What is your current position and role?
-can you briefly describe your past roles and educational background?

2. How do you currently use technology in your role?
-what specific technologies affect your role the most?

3. What sorts of technology do you consider to be *health technology* (or technology used for healthcare purposes)?
-what attributes do you think makes a technology relevant to health or the healthcare context?
- in your own words, how would you define 'health technology'?

4. Please describe to me how you have learned about technology in the past?
did your learning originate from a formalized education session, or, something more spontaneous?
what were the steps taken to start learning about the technology?
how long did it take you to learn about the technology?
can you describe the factors in the environment assisted your *learning?*
can you describe the factors in the environment detracted from your *learning*?
can you describe who initiated the learning?
was learning the technology mandatory in your role? Please describe…
did everyone use the technology, or were some reluctant? Please describe…
did learning process assist you in operating the technology? Please describe…

How has learning about this technology changed your thoughts about future health technology?
- how do you plan to learn about technology in the future?

Appendix C: Consent Form

I have read the letter of information provided for the study "*Nurses' Learning and Conceptualization of Technology used in Practice*" and have had the nature of the study explained to me. Similarly, my questions pertaining to the study have been answered to my satisfaction, and I agree to participate in this study.

Printed name of participant:_____

Signature of participant:_____

Date: _____

Printed name of person obtaining informed consent: _____

Signature of person obtaining informed consent: _____

Date: _____

Appendix D: Ethics Approval

Research Western

Use of Human Participants - Ethics Approval Notice

Principal Investigator: Dr. Mary Anne Andrusyszyn
Review Number: 17950E
Review Level: Delegated
Approved Local Adult Participants: 40
Approved Local Minor Participants: 0
Protocol Title: Nurses' Learning and Conceptualization of Technology used in Practice
Department & Institution: Nursing, University of Western Ontario
Sponsor:
Ethics Approval Date: April 08, 2011 **Expiry Date:** August 31, 2012
Documents Reviewed & Approved & Documents Received for Information:

Document Name	Comments	Version Date
UWO Protocol		
Letter of Information & Consent		
Other	Recruitment Email.	

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research

Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The UWO HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Signature

Ethics Officer to Contact for Further Information

Janice Sutherland	Elizabeth Wambolt	Grace Kelly

This is an official document. Please retain the original in your files.

The University *of* Western Ontario
Office of Research Ethics

Curriculum Vitae

Name:	Richard G. Booth
Post-secondary Education and Degrees:	McMaster University Hamilton, Ontario, Canada 2000-2004 BScN The University of Western Ontario London, Ontario, Canada 2004-2007 MScN Western University London, Ontario, Canada 2007-2013 Ph.D.
Honours and Awards:	Ontario Graduate Scholarship 2007-2008; 2008-2009 (declined in favour of SSHRC CGS) Social Science and Humanities Research Council (SSHRC) Joseph-Armand Bombardier Canada Graduate Scholarship 2008-2011
Related Work Experience:	Registered Nurse Adult Psychosis, Regional Mental Health Care St. Joseph's Health Care London 2004-current Adjunct Professor (SGS Associate Member) Institute of Health Policy, Management and Evaluation University of Toronto 2009-current Instructor School of Nursing McMaster University 2010-2012 Lecturer Arthur Labatt Family School of Nursing Western University 2012-current