Learning technology while providing patient care: A grounded theory study on the experiences of nurses adopting new technology

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Abstract

Nurses must be prepared to adopt new technology in their role at an increasingly rapid pace. Nurses are required to have the digital skills to navigate, use, troubleshoot and adapt to new technology as part of their clinical practice. Skill and comfort level using technology, as well as nurses' perceived value of new technology varies significantly. Training fills the skill and knowledge gap between nurses and technology to enable them to use new digital tools. This study seeks to understand the relationship between nurses, technology and training and their experiences adapting to new technology in their role. Fourteen nurses working in two major hospitals in British Columbia participated in this grounded theory research study. Participants were involved in either small focus groups, one-on-one interviews, or co-design activities to generate data regarding nurses' experiences with technology adoption.

Concurrent data analysis was conducted throughout the data collection process, using coding methods to categorize and thematically group ideas that emerged in transcripts and field notes. The findings from the focus groups and interviews emphasize the (1) variety of skills and comfort among nurses using technology, (2) need for nurses to be able to troubleshoot technology, (3) need for time to adjust to new technology, (4) desire for hands-on training and support, and (5) relationship between patient and technology. During the co-design activities, participants prioritized training methods based on the impact and effort. Participants prioritized training methods in order of hands-on practice time, quick demonstrations while on shift, online learning at home, and finally written how-to guides.

As a result, this study proposes a theory that training for new technology should include a tangible, hands-on training aid that replicates new digital tools. The training aid must be readily available for nurses to interact with to increase their confidence and capability adopting new technology into their practice.

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Chapter 1. Introduction

My journey in inclusive design began with a phone call from a nurse. The nurse needed to join a virtual class, but was having difficulty setting up their computer. The class was to teach them about the newest digital tool that they would be using to support patient care. On the phone, the nurse sounded frustrated and stressed. This phone call took place in spring of 2020, while a global pandemic was taking place and health care workers were working tirelessly to ensure the health and safety of others. This additional stress and frustration for the nurse seemed unnecessary; as nurses already have a difficult role, stress and frustration from learning new technology should not be another challenge for them.

Yet, these challenges and these feelings are not unique to the nurse who I was on the phone with. Nurses must continue to adapt to new technology in their role as the increase and acceleration of digital health care continues across Canada (Innovation, Science and Economic Development Canada (ISED), 2018). With the increase in technology, comes the need for nurses to be capable at navigating new digital tools while providing patient care (Montague & Asan, 2012). However, not all nurses have the digital literacy skills or the confidence with digital tools required to adapt to new technology as it becomes embedded in their practice.

Health care settings that adopt technology into their work practices means improved access to patient records, more streamlined and efficient care, and improved patient care, among other benefits (Chang & Gupta, 2015). Adopting new technology puts a demand on nurses to learn the skills and have the confidence to use this technology; however, this demand on nurses reveals challenges such as poor digital literacy and negative reactions, including frustration, burnout, change fatigue and added stress (Boonstra & Broekhuis, 2010; Chang & Gupta, 2015; Hansen et al., 2021; Terry et al., 2009). Many of those factors can have detrimental impacts such as staff leaving the profession (Biron, et al., 2019; Hansen et al., 2021) or becoming change resistant to new technology (Boonstra & Broekhuis, 2010). Training is a solution to ensure nurses build the skills and confidence to use technology (Atack et al., 2004; Baumgart, 2020; Boothby et al., 2010). Yet, as described in the scenario with the nurse on the phone, current training may not be designed to be accessible or meet the needs of nurses who are impacted by this technical innovation.

This research study seeks to understand the relationship between nurses, technology, and training, as well as examine the experiences of nurses learning new digital health tools in the workplace. This study seeks to propose a training design to meet the needs of nurses who are underserved in current training practices. Further, this research study is framed within the relationship between individual (subject) and technology (object) and how those two interact. This approach is rooted in the interpretation of Canadian philosopher Marshall McLuhan's theory that technology becomes an extension of man (McLuhan, 1994) which I understand to mean that although technology may be created objectively, when being used by humans it takes on meaning and understanding that is subjective. Thus, understanding the experiences between nurses and technology to theorize how to design education to acknowledge this relationship and meet the needs of individual learners.

Chapter 2. Literature review

2.1 Adapting to new technology in health care

The introduction of new digital tools in health care changes the responsibilities and skills of nurses and thus requires them to adopt new technology (Chen et al., 2022; Salas et al., 2012; Tran, 2021). However, many studies have identified that the adoption of these tools is dependent on the comfort, confidence and skills nurses have using technology (Boonstra & Broekhuis, 2010; Khare et al., 2022; Koivunen et al., 2008; Mills et al., 2015; Saranto & Leino-Kilpi, 1997; Shorten et al., 2001; Terry et al., 2009). This knowledge and behaviour towards technology is referred to as computer and digital literacy, which includes skills such as (1) the basic use of computers, (2) navigating technology, (3) using technology to search and find information, (4) using technology to communicate, and (5) using technology to record and manage digital records (Koivunen et al., 2008; Lee et al., 2019; Terry et al., 2009).

In a study conducted in 2019 on the experiences of nurses using a new electronic charting system, it concluded that a lack of digital literacy skills resulted in nurses feeling stressed and nervous about the adoption of digital tools (Lee et al., 2019). As a result, nurses stated that they preferred paper documents and old charting methods as they felt more confident to be able to provide patient care (Lee et al., 2019). This finding is consistent with studies that examined the experience from the patient point of view, which concluded that the trust patients have in their providers is based on how patients observed their provider using technology while in their care (Montague & Asan, 2012). Studies over the last few decades have researched the importance of training, as well as specifically what content should be included in training to ensure it provides nurses with the necessary technical skills to successfully adopt technology (Atack et al., 2004; Boonstra & Broekhuis, 2010; Chang & Gupta, 2015; DeHart et al., 2022; Gibson et al., 2020; Guise & Wiig, 2017; Khare et al., 2022; Koivunen et al., 2008; Lee et al., 2019; Limaye et al., 2015; Mills et al., 2015; Saranto & Leino-Kilpi, 1997; Verma & Gupta, 2016).

2.2 Training as a solution for technology adoption in health care

Tracie Risling, Vice-President of the Canadian Nurses Association, argues that increasing digital literacy among nurses is a critical step in building motivation among nurses to adopt digital tools (Risling, 2020). Whether it is new skills or an upgrade of current skills, training plays a critical role in users' attitude towards new technology (Atack et al., 2004; Boothby, 2010; Guise & Wiig, 2017). The research conducted by Boothby, Dufour and Tang concluded that there is evidence of the relation between technology adoption, training and productivity among workers (2010). As studies illustrate, nurses are motivated to adopt new technology once they receive training and training increases motivation to use new technology (Risling, 2020).

As new technology roll out is happening rapidly, training must be available quickly and widely, so e-learning has become a common solution to teach nurses the new skills and abilities to use digital health tools (Beinicke & Kyndt, 2020; Moule, Ward & Lockyer, 2011). The definition of e-learning is evolving as new technology becomes available, but is broadly described as a learning method that uses technology – whether web-based tools, mobile tools, social media, or any information and communication technology – to teach (Moule, Ward & Lockyer, 2011). Globally, many studies have been conducted to develop training content aimed at increasing telehealth skills, computer literacy and specific software skills among health care workers (Matthews, 2021). In 2004, researchers conducted needs assessment surveys, interviews and observations of Canadian health care workers to create an online, team-based course to teach health care workers how to use digital tools to conduct telehealth appointments (Atack et al., 2004). Further, in 2017 researchers from Norway held focus groups with health care workers to identify the main learning outcomes that should be included in telehealth training (Guise & Wiig, 2017). Both case studies used co-creation methods with health care workers to develop training content to address what skills and knowledge are most important in their roles. However, neither case study provided an explanation of how the training would be implemented and delivered to the larger network of health care workers in the organization.

Other researchers have argued that given the importance of digital literacy among nurses, it is critical to incorporate this training into early nursing curriculum before they enter the profession (Gibson et al., 2020; O'Connor et al., 2017). This would help to build the confidence and capabilities to adapt to the evolving digital health care systems (O'Conner et al., 2017). However, as digital literacy training is not currently built into the nursing curriculum, it must be incorporated within the training that nurses receive on the job.

Some of the challenges that make offering on-the job training for digital health tools difficult include the time constraints of nurses trying to fit in all the required training, the variance in skill level among nurses, the generational differences, and the different attitudes towards technology (Koivunen et al., 2008; Terry et al., 2009; Verma & Gupta, 2016). Relying on e-learning is a valuable way to save time and increase access (Moule, Ward, & Lockyer, 2011), however many studies point to the lack of transferability between what is taught in online training sessions and what is applied while on the job (Beinicke & Kyndt, 2020). This finding aligns with the work of Baldwin and Ford's transfer of training model, in which they question why so much money and time is spent on training that appears to often be ineffective as it does not always seem to be applied on the job (Baldwin & Ford, 1988). This model illustrates how only a select amount of what is taught actually transfers to the employees (Baldwin & Ford, 1988). Moule, Ward and Lockyer specifically studied the effectiveness of e-learning among nurses and identified that e-learning takes an instructivist approach, which places the learner in a passive role and gives the educator a more central role focused on delivering knowledge rather than seeking to generate a common understanding among learners (2011).

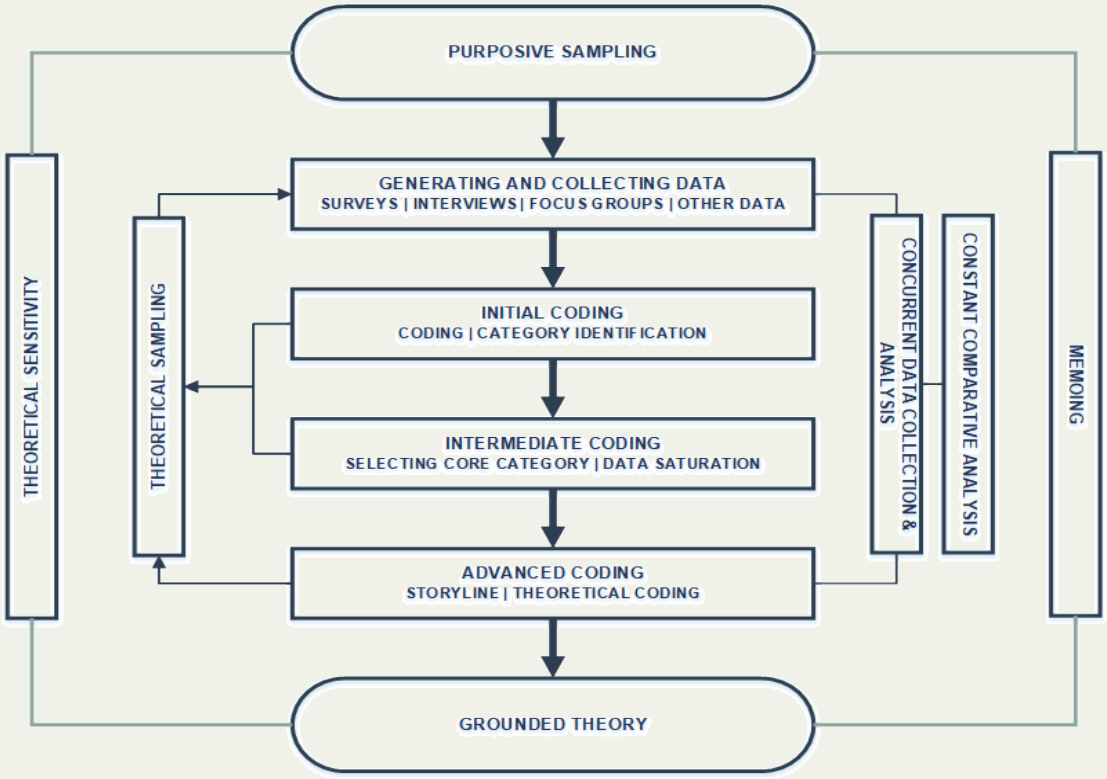
2.3 Applying a theoretical interpretation to training systems

Questioning the effectiveness of e-learning as a training solution for digital tools (Moule et al., 2011) relates to the statement by Canadian theorist Marshall McLuhan, "the medium is the message" (1994). This phrase implies that the tool which one uses to communicate a message carries value and power (McLuhan, 1994). My interpretation of McLuhan's work is that one must carefully examine the effect of using a digital training platform, such as e-learning, to provide training for digital tools. What impact does that structure have on learners? Exploring this concept of embedded power dynamics within an infrastructure relates to the work of philosopher Michel Foucault. In his book, The History of Sexuality he explains the role of power within a system (Foucault, 1978). Foucault's definition of power is not specific to an institution or a hierarchy, but rather he argues that power exists as a complex force throughout society (1978). His examination of power within educational institutions extends beyond the power dynamics between educators and learners and rather considers the overall structure including the environment, the other stakeholders, and the monitoring systems used (Foucault, 1978). Foucault's definition of power dynamics is explored in the interpretation by Brazilian educator Paulo Freire's critical pedagogy theoretical framework. Freire's framework implies that education systems are built on one-way power dynamics where educators hold the power over learners, and this perpetuates the idea that those with knowledge hold power over those without (1986). He argues that education should be designed so that learners are active participants in their learning and that knowledge should come as a collaborative and generative process between educators and learners (1978). To further examine the role of power dynamics within training systems for nurses, this study uses a grounded theory approach and inclusive design methods to develop a theoretical framework for the design of a more comprehensive education model for digital tools.

2.4 Using grounded theory in research

This study aligns with the grounded theory framework developed by researchers Barney Glaser and Anselm Strauss. In their book, The Discovery of Grounded Theory, they define this form of qualitative research as the process of "generating a theory from data [which] means that most hypotheses and concepts not only come from the data, but are systematically worked out in relation to the data during the course of the research" (Glaser & Strauss, 1967, p. 6). Many concepts have been identified in the literature and in my own experience working with nurses as important areas for consideration. These include the overall skills and abilities of nurses using technology, the design and infrastructure of the training, and the power dynamics between the stakeholders and the system with which the training operates in. These concepts are broad and not specific to the current situation at Fraser Health. Thus, by using a grounded theory approach I take these general concepts and begin the process of conducting research, coding data, conducting further research, analysing data, and repeating this process to draw a theoretical conclusion. Figure 1 outlines this iterative process to conduct research.

Figure 1. *Framework for conducting grounded theory research*



Note. This framework illustrates the cyclical process of collecting data and analyzing data to generate a theory grounded in research. The framework is from "Grounded theory research: A design framework for novice researchers" by Y. Chun Tie, M. Birks, K. Francis, in SAGE Open Medicine, 7 (p. 3), 2019 (Link to article).

This research collects data from nurses who work in various roles, from a variety of departments, from multiple acute sites across the Fraser Health Authority in British Columbia. The reason for including nurses from all levels is to gain an in-depth understanding of the diverse systems and dynamics in which nurses work and learn technology in. Current research studies encourage organizations to develop standardized digital literacy training for nurses (O'Connor et al., 2017). However, instead of seeking out standardized design solutions, this research takes an inclusive design approach to data collection, interpretation, and design.

2.5 Applying inclusive design principles

Standardization has a long and important role within the health care system (Bowker & Star, 1999). Bowker and Star's research on classification systems within organizations, including health care systems, identifies the importance of standardization in the nursing profession (1999). This includes the development of the Nursing Interventions Classification system, which provides a regulated set of codes and language that is widely recognized across the profession (Bowker & Star, 1999). This standardized system allows for nurses from different roles and different departments to communicate efficiently and quickly, which are important values within the health care system (Bowker & Star, 1999). However, Bowker and Star acknowledge that a one-size-fits-all-approach does not always work when it comes to building confidence or capability among users (1999). Critics of this standardized system argue that there is value in applying a more individualized lens to health care systems to increase confidence or capability (Bowker & Star, 1999). Questioning this role of standardization among training and technology also appears in Risling's article where she states that it is critical to focus on the qualitative experience of the users of technology and not solely on the quantifiable key performance indicators associated with technology (Risling, 2000). Bowker and Star acknowledge that standardized, quantifiable systems embed ethical and political values within them, which may not be inclusive off all individuals within the system (1999). Therefore, by being aware of this, one can "...keep open and can explore spaces for change and flexibility that are otherwise lost forever" (Bowker & Star, 1999, p. 321) which advocates for the importance of applying inclusive design methods to this work.

Inclusive design within the context of education is defined by authors Philips and Colton (2021) as "...design that considers the full range of human experience and focuses on the needs of users on the margins to help provide a better learning experience for everyone" (Chapter 9). I interpret inclusive design as the antithesis to standardization, in which we look to design processes or experiences that may not be applicable to everybody but rather can improve the experience for those who are typically excluded from standardized systems. As it's been acknowledged, designing a standardized digital literacy training to meet the numerous differences among health care workers such as skill level, generations, and attitudes is a challenge (Koivunen et al., 2008; Saranto & Leino-Kilpi, 1997; Shorten et al., 2001; Terry et al., 2009).

This research seeks to understand the unique experiences of nurses working at Fraser Health and to find elements of their learning needs which may be excluded in current training practices. Jutta Treviranus created three dimensions of an inclusive design framework, which are at the root of this research. The first dimension is to recognize and design with human uniqueness in mind (Treviranus, 2018) imploring the researcher to avoid trying to group participants into predetermined boxes, and rather let those differences be a meaningful part of the research. The second dimension is to use methods that include people with a diversity of perspectives, including both those that can and those that cannot use current systems (Treviranus, 2018), which is why this research does not require nurses to complete digital literacy pre-assessment to determine their inclusion in the study. Third, acknowledge that design happens in a complex and adaptive system (Treviranus, 2018) which is recognized as this research strives to produce a framework grounded in research specific to the experiences of nurses within this study. Thus, this research seeks to understand the experiences of nurses learning technology and focus on topics such as autonomy, collaboration and hands-on training experiences which have been recurrent themes in literature.

2.6 Recognizing autonomy, collaboration, and hands-on experience in training

Personalization and autonomy are themes that came up frequently among literature related to nurses' training needs. The research of Limaye et al. questions how teaching technology can be personalized for the health care worker using it (2015). Recognizing that many areas have various levels of education and access to digital tools, health care workers need to be flexible and adapt technology to fit their needs (Limaye et al., 2015). Their careful examination of the Global Health eLearning Centre exemplified how health care workers have been able to modify the intended use of technology to meet their needs in practice (Limaye et al., 2015). This is further illustrated through Fenwick's research, which argues that technology can only act in accordance with their interaction with humans (2013). Thus, she encourages researchers to focus on the

relationships between people and technologies (Fenwick, 2013). In studies related to burnout and addressing the needs of nurses, it was discovered that a lack of control or autonomy over their work serving patients was a leading factor in health care provider burnout (Dyrbye et al., 2017). This is reiterated in the interviews conducted with nurses working in Canada who mentioned that greater autonomy in their role would lead to an improved working environment (Campbell et al., 2020).

Further research studied how collaboration among nurses would positively impact training environments and technology adoption. The World Health Organization (WHO) defines interprofessional collaboration as the practice that happens when "...multiple health workers from different professional backgrounds work together..." (World Health Organization Study Group on Interprofessional Education and Collaborative Practice, 2010, page 7). In the report, the WHO identifies that interprofessional collaboration can be applied in learning settings and as a result can help build more collaborative relationships among health care workers, while ensuring they are better equipped to provide health care (2010).

Results from a study conducted in 2020 concludes that a teams-based approach to training was the most effective in building confidence and capacity to effectively use and adopt digital health tools (Zittleman et al., 2020). Beyond the positive impact that collaboration has on the learning and adoption of technology (Zittleman et al., 2020), Dyrbye et al.'s longitudinal study identified a lack of collaboration as a factor in burnout among health care workers (2017). Moreover, in their podcast capturing their personal and shared experiences as nurses in North America, hosts Jamie Baker and Sarah Matthews discussed that one solution they had to mitigate burnout from the profession was to find ways to collaborate with different professionals which kept them feeling motivated in their career and improve their own skill set (Baker & Matthews, 2022). In an interview with Dr. Katharine Smart, former-President for the Canadian Medical Association, she acknowledged that increased collaboration among practitioners enables them to continue to learn from one another and provide better patient care (Maheux, 2022). Furthermore, collaboration among health care workers provides opportunities to learn from one another, and ensures they are using digital tools in the right way

to guarantee efficient care is provided (Gutierrez, Kuperman, & Kaboli, 2021). Thus, collaboration should be a key factor in designing future training solutions for effective technology adoption.

Nurses have identified that having hands-on, practical training is beneficial to applying what they learn directly to their role and patient care (Gibson et al., 2020). During the focus group sessions held by Guise and Wiig on health care worker perceptions to training needs, one participant states that the "…best way to learn it is to use it. We need training where we get to try the equipment ourselves, to know how it works, [to see] what gives the most beneficial effect" (Guise & Wiig, 2017). This statement is reiterated in research done by Woods and Rosenberg who proposed strategies for implementing more engaging and active learning approaches (2016). They stated that clinicians should be engaged in learning processes directly with the tool, instead of having to invest extraneous effort into learning processes or tools that are not directly tied to the tool (Woods & Rosenberg, 2016). Further to this point, research identifies that training for telehealth should be reinforced through hands-on practice while in clinical settings (Gibson et al., 2020). The desire for learning and practicing using digital health tools accommodates the flexibility that is required while working with changing patient needs and demands (Gibson et al., 2020). This further aligns with Bowker and Star's ideas that standardization in training embeds certain values that negate from the flexibility and change required in current systems (Bowker & Star, 1999).

2.7 Designing an inclusive, grounded theory research study

As described in this literature, nurses require adequate training to feel confident and be motivated to use digital health tools to provide patient care. Consequently, this research does not focus on what content needs to be included in training, but rather on how training and the methods used for training can be designed alongside nurses to address the individualized needs and the diversity of nurses.

Chapter 3. Methods

3.1 Setting and participants

This qualitative study collected the experiences of nurses working in hospitals across the Fraser Health Authority region in British Columbia. Participants included nurses working in any department or unit who use technology as part of their role. To increase transferability of the study, three hospitals were selected to hold the research at to ensure that findings were not subjective to one hospital with unique experiences among nurses. The recruitment details were sent out to Clinical Nurse Educators, lead nurses, project leaders in the information technology department and hospital librarians. These stakeholders proceeded to disseminate the study information to their network of nurses across the health authority. The choice to recruit at Surrey Memorial Hospital, Royal Columbian Hospital and Abbotsford Regional Hospital was purposeful to capture the geographical distance between sites. Fraser Health Authority is in the process of implementing an electronic health record in the coming years to replace paper-based health records (Fraser Health, n.d.) therefore, this research intentionally took place where the implementation of the electronic health record has not started so that any findings from this research could be applied to the future rollout at these sites.

This study recruited a total of fourteen nurses to share their experiences learning and using technology at Fraser Health. Participants were not assessed ahead of time on their technical skills; this was intentional to gather a diverse range of perspectives and abilities throughout the research. Nurses were from different roles including Licensed Practical Nurses, Registered Nurses, and Clinical Nurse Educators, as well as from different departments including surgical, maternity, cardiac, nephrology, and neurology. This study size aligns with other qualitative studies examining health care worker-technology relationships. Common study sizes in this area include 10 – 20 participants with a range of skills, abilities, experiences and from multiple departments. For example, the mixed methods study conducted by DeHart et al. recruited seventeen providers and prioritized having a variety of working locations and experiences to study (2022). This study size reflects qualitative studies

on people, however the study sizes for clinical studies and technology studies tend to be higher. Specifically, in the work by Bowker & Star on standardization within health care they state that it must be comparable across many sites and leave a margin of control for users (2000) illustrating how a larger study size would rule out any irregularities among users. While technology strives to be standardized across many workers, this study and the sample size is taking an inclusive design approach that focuses on designing for the individuals impacted and not an 'averagarian approach' which aligns with concepts of standardization or classification (Rose, 2016). As this research was conducted on-site at hospitals with health care workers, additional considerations regarding the ethics and approval were required.

This research required Research Ethics Board approval from both OCAD University and Fraser Health Authority. In addition, verbal permission was required from site administrators, coordinators, and unit leads before hanging recruitment posters and/or being on-site. The researcher conducted both scheduled focus groups as well as impromptu interviews. The focus groups were scheduled during the day, with the aim to take place between nursing shifts. However, a typical nursing shift varied across sites and departments. The researcher received replies from nurses stating that they were interested in the research, but were unable to participate for a variety of reasons. The reasons included a lack of childcare options during the focus group time, being on shift during the focus groups, and the location of the focus groups being too far from where they live or work. These factors impacted participation and in the end the researcher had six participants signed up for the focus groups. This included two participants at Surrey Memorial Hospital, two at Royal Columbian Hospital and two at Abbotsford Regional Hospital (neither participant at Abbotsford Regional Hospital showed up for the focus group). As a result, the researcher conducted impromptu interviews at both Surrey Memorial Hospital and Royal Columbian Hospital to encourage participation and to reach nurses who did not receive the study invite or were unable to participate in the focus groups.

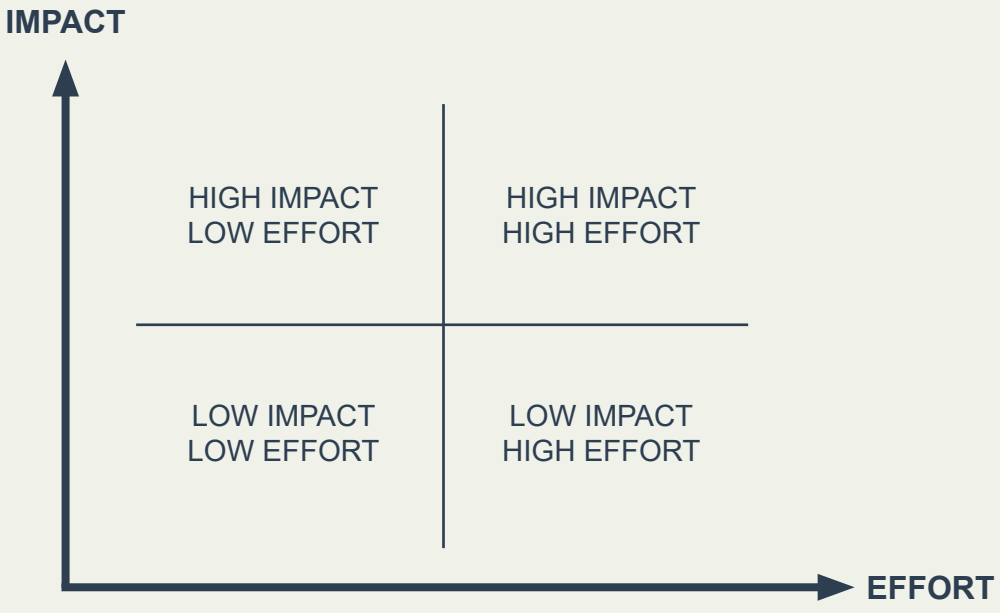
The interviews were conducted during the night shift where the researcher walked around to different departments recruiting and holding on the spot interviews. This method was successful and ten nurses participated in the interviews. Participation depended on how busy the hospital was that night with patients. This method was successful due to (1) time, (2) availability, and (3) involvement. The interviews were conducted with nurses during their shift in their department ward, which meant that they were not required to travel or to use their time off to participate. In addition, by choosing to interview during the night shift, department wards are typically less busy and patients are sleeping, meaning that nurses have availability to participate. Finally, nurses were eager to be involved, as night shift nurses are commonly not included in research activities that happen typically during 'business hours'. This also meant hearing more perspectives that are not usually included. To align with inclusive methods in grounded theory, the researcher insisted on in-person data collection methods instead of surveys or virtual sessions. The researcher received requests for digital surveys to be sent to expand the reach and participation, however the data collection methods were guided and prioritized through the ongoing analysis and therefore a survey would not have aligned with this qualitative study.

3.2 Data collection procedure

As this research was conducted using grounded theory methods, the data collection process was iterative and took place over a span of three weeks. The first focus group held at Surrey Memorial Hospital took place as a question and answer (see Appendix A) between the researcher and participants. Following the focus group, the researcher conducted a thematic analysis of the audio recording, transcription, and field notes to look for major themes. These themes were cross-referenced during the next focus group with different nurses. The next focus group held at Royal Columbian Hospital continued the question-and-answers, while incorporating themes that emerged from the first focus group. After this, another thematic analysis was conducted to compare major themes.

These themes guided the next set of questions that were asked during short interviews (see Appendix B) with night shift nurses. These interviews were translated into follow up questions and co-design activities that were presented at the second round of focus groups. These focus groups were held at Surrey Memorial Hospital and Royal Columbian Hospital again with the same nurses who participated in the first round of focus groups. The themes were presented as an activity for nurses to rank the training methods based on impact versus effort. Impact refers to what kind of impact this training method has on their individual learning related to new technology in their role, and effort is interpreted as the effort it takes for them to participate in training. Figure 2 depicts the activity nurses participated in.

Figure 2. *Impact versus Effort Matrix*



Note. This matrix represents the decision-making activity that was used to prioritize the training methods gathered during the data collection period. The matrix is inspired from the suggested activities on the "Design and co-creation" from the Government of British Columbia (n.d.) on the B.C. Government website (Link to website).

After these focus groups were concluded, a final round of interviews was held with night shift nurses at Royal Columbian Hospital. The purpose of these interviews was to confirm the findings and priorities that had emerged thus far. All participants (from the focus groups and the interviews) were assigned a code and all data collection (field notes and transcripts) referred to the participant by their coded name so that no names or identities were revealed. This concluded the data collection process.

3.3 Materials

For this study, the researcher came prepared with a semi-structured outline of questions to ask participants. For the follow-up session, the researcher presented participants with synthesized themes, markers and post-it notes for the participants to prioritize the themes moving forward into the design stage. All interviews were recorded so they could later be transcribed.

3.4 Data Analysis

The initial qualitative data analysis method used was thematic analysis. This method was used after the first round of focus groups and the first round of interviews. The researcher reviewed audio recordings, transcripts, and field notes to conduct initial coding and identify categories and themes that were repeated throughout each participants' responses. The focus groups and interviews were intentional choices to ensure that it was a conversational approach between the researcher and the participant. This allowed each participant to interpret the questions and respond with stories related to what mattered the most to them. The patterns that emerged from the first focus groups revealed themes that were not initially anticipated and were thus introduced in the interviews with participants to identify whether it was a recurring or a common

experience among nurses. This was part of the intermediate coding process, in which core categories were selected to transform the data into concepts that could be explored through additional data collection (Chun Tie et al., 2019).

Once the interviews were concluded, another thematic analysis was done to identify issues or opportunities that were consistently mentioned among participants. These findings were synthesized and presented during the second round of focus groups as a post-it notes activity (Figure 2). After these focus groups, the researcher conducted another round of intermediate coding of the co-design results to refine the themes and questions that would be included in the final interviews. It was important at this part of the research to review field notes as they revealed a lot about the participants' mannerisms and interactions between each other that were not captured in the post-it note activity. After the conclusion of the final set of interviews, the researcher conducted a complete content analysis of all interview transcripts and focus group transcripts. This analysis involved going line by line through all transcripts to code the statements. During this advanced coding period, the researcher revisited field notes and transcripts to begin the theoretical coding and develop the overarching narrative that emerged related to the nurses' experience using, learning and adapting to technology in the workplace.

Chapter 4. Findings

This section summarizes the findings from all three stages of data collection: the focus groups, the follow-up interviews, and the final co-design activities. The findings are summarized from direct quotes from participants, images from the activities, as well as field notes. Field notes are a critical part of the grounded theory process as it ensures quality within the research (Chun Tie et al., 2019). Before, during and after each data collection process, notes were collected to capture the body language, tone and feelings of participants. These additional observations provide support to the data and add a reflective process to document ideas and thoughts that emerged throughout (Chun Tie et al., 2019). These notes prompted early analysis to find initial themes in the research and inform the next set of data collection processes.

4.1 Findings from the focus groups

The goal of the focus groups was to gain an understanding of the relationship between technology and nurses. The questions (found in Appendix A) were intended to understand how nurses learn about new technology being introduced in their role, how to use technology, and how they navigate challenges they encounter. The findings from the focus groups are categorized in three overarching themes:

- Variety of skills and comfort using technology
- Need to troubleshoot technology
- Need for time to adjust to new technology

4.1.1 Variety of skills and comfort using technology

Participants shared their personal experiences using and learning technology on the job, as well as what they have witnessed among their colleagues. Participants shared that there are many different levels of skills and comfort among nurses. One participant stated that they felt more comfortable using technology and described their experience of working with or helping fellow nurses who they identified as not being as capable using technology:

> I think the other thing with the technology piece is... trying to explain it and show people who are not as computer savvy... there's a number of nurses who only have very basic understanding of using computers, right, so they know enough to do their job, but not much beyond. (Participant 1) [focus group]

Some participants attribute the variety of skills to be age-related. One participant suggested nurses in their forties were the most adept at using technology:

> I find actually, a lot of the most versatile are the [nurses] my age [mid-40s] where we had no technology, and then we got introduced to all of the stuff that didn't work well to begin with and have progressed through. (Participant 1) [focus group]

The findings indicate that adapting more easily to technology does not mean a nurse is better at their job. An interesting finding emerged where one participant claimed that the reliance on technology among younger generations of nurses negatively affects their abilities as a nurse, "We would assume that the younger generation are a little bit more easy to pick up new technology. I find that sometimes, not always, technology can make people dumber..." (Participant 3) [focus group]. Another participant agreed on this negative impact of technology, and shared that the overreliance of technology negatively impacts the nursing skills of some nurses, "Not just that, I find we get too focused on the technology... we forget to look at the patient" (Participant 4) [focus group].

Other participants did not directly identify age as the reason for being less skilled with technology, but rather noted that there is a lack of comfort

using technology, "...you get different people who have different levels of comfort with technology" (Participant 2) [focus group]. Some suggested it may come from a fear of breaking something, "…some who are more timid, don't just want to click on things. Yeah, other than just like, click here and try this and try that and see if it works, but they're a little less willing to do that" (Participant 1) [focus group].

One participant discussed the importance of giving nurses time to play around and get comfortable with technology before they need to use it to provide patient care:

> I find once it's more hands on the staff retain the information because they get to try it themselves... they can just play with it so that you know, they're not going to be worried about breaking it or affecting the patient. (Participant 4) [focus group]

The importance of getting comfortable using technology by playing around with it relates to how nursing education is provided. A few participants shared their experience with a See-Watch-Do model of training in which they see how a tool is used, watch a demonstration of it being used, and then do it themselves. The participant shared that this is a helpful way for a nurse to become comfortable using technology, "... we're so used to having to at least see one, and then watch...and then we have to be able to demonstrate [do] in a lab and then get tested. Yeah, see watch do sort of concept..." (Participant 3) [focus group]

All participants acknowledged that learning to use new technology was dependent on nurses' individual skills and abilities, which varied significantly. However, the variety of skills relates to the comfort a nurse has playing around with technology and troubleshooting when presented with challenges.

4.1.2 Need to troubleshoot technology

Participants shared that they experience challenges with technology when it does not work or when it fails. This revealed themes of troubleshooting or needing to find solutions to make technology work in their setting. As one participant shared in the first focus group, "Nurses have lots of workarounds. So like, yeah, if something's not functioning, we will find a workaround to try to get it to work" (Participant 1) [focus group]. However, many participants agreed that this can cause feelings of frustration for nurses:

> If you have to troubleshoot it [technology] a lot, then... it gets very frustrating, because you have to redirect your time to fix something else… So, when it works well, it's fine. It's when it's not working great that we start to get frustrated. (Participant 1) [focus group]

Some participants stated that they feel confident playing around to try to fix technology when it does not work, "... And so, you know, just not sure what to do or how to troubleshoot something, and I usually just jump in and play around and figure it out as I go" (Participant 2) [focus group]. When discussing what happens when technology fails, there was a distinction between generations and how they respond to technology failing:

> I do find that at least [the] older generation, if something technology wise breaks down, they will adapt to like assessing the patient. Like do your nursing part, right? Like critically think through, but they're not critically thinking through what's wrong with that piece of technology, though... But, they would go to like what we do best as in like, technically we're supposed to care for patients, right? Whereas the younger generation I find, if you're overly dependent on what monitor is showing, you forget how to deal with patients... (Participant 3) [focus group]

Being able to troubleshoot technology and being able to adapt one's practice to technology failing was identified as an important factor in the nurse-technology relationship. However, regardless of the challenges nurses face, it is clear that nurses expect technology to continue to be a significant part of their role and require time to adapt to it.

4.1.3 Need for time to adjust to new technology

Participants have the expectation that technology is and will continue to be an important part of their role, however none of the participants seemed to think that technology would change their role significantly or replace their role as care providers, "…I feel like technology is great, and it helps us out. But, it's never going to replace the actual, like, hands on person to person part of our job..." (Participant 2) [focus group].The value of technology varies for participants dependent on how well designed it is to meet their needs. When new technology makes the work of nurses harder or more complicated, nurses will not adopt it. Two participants discussed a new digital system at their hospitals to track updates instead of recording them on a whiteboard. Both participants agreed the new system is overcomplicated, time consuming and did not meet the needs of nurses; as a result, it took a long time for nurses to adapt to using this technology:

> Traditionally, they just need to make a phone call. So now you have three different interfaces open… they're not the easiest… traditionally, all they need to do is pick up a pen, erase and a patient's done... (Participant 3) [focus group]

Participants agreed that by overcomplicating what was previously a simple process, it led to questioning the value of technology, "Like, what's efficient? User friendly? Yeah. Adding more work to my work" (Participant 4) [focus group]. This idea of efficiency is reiterated by another participant, "Good intent with technology, but wasn't really thought through very well... it leaves a little bitter taste in people's mouth, and that this system is not efficient, even though the intent was to make it efficient" (Participant 3) [focus group].

Nevertheless, all participants agreed that even if a system is well-designed and improves workflow, nurses will still require time to adapt to this change and become comfortable with it:

> I think that transition is always the most challenging time. Because, again, they're [nurses] trying to adapt, but they know the old ways. They're used to it... and then now you want us [nurses] to change. So, it's always that transition it's always the most challenging time… It's figuring out, okay, some of the nurses might be more adaptable to the change, while others might be more challenged. (Participant 4) [focus group]

In terms of how to manage this challenge, not having enough time results in slow adoption. Participants require organizations and leaders to build in time to recognize the learning curve for new technology. One participant recalls a time they were trying to adopt many new virtual tools at once and how difficult it was to find time to learn how to use all the features of the tools:

> That also was a lot of learning on the fly… and makes it quite challenging to become adept, as well. And there's lots of items that you're trying to accomplish. So we kind of get to like, okay, I can use all these features, and they have so many more features that just like [I] haven't really looked at. (Participant 1) [focus group]

Another participant reiterates the importance of having time for learning:

> The time it takes to learn it [technology] and get used to it and whatnot, like our days are already pretty busy... if I'm dealing with a new system or something, obviously, the learning curve will slow things down. (Participant 2) [focus group]

In summary, participants are aware and accepting of technology as part of their role, however it is important to ensure it aligns with their needs and to give them time to accept it, otherwise risk being met with nurses questioning the overall purpose of the technology, "I mean, it's human nature. Because they're used to it right. That's their comfort zone, so why change things when it is working?" (Participant 4) [focus group].

4.2 Findings from the interviews

The goal of the one-on-one interviews was to understand what specifically impacts nurses' ability to learn skills, troubleshoot technology and find time to adapt to new technology. The questions (found in Appendix B) were intended to identify the relationships and structures that enable nurses to learn about technology, to understand their abilities to navigate technology, and to recognize what impact they perceive technology to have on their role. The findings from the interviews resulted in two core themes:

- Hands on or on the spot support and training
- Navigating the relationship between patient and technology

4.2.1 Hands on or on the spot support and training

Participants express a preference to receive on-demand training and support, in which they prefer to learn something as they need it, apply it directly and when support is needed, have immediate access to help. Participants share the pros and cons with online learning and their preference for a hands-on learning method:

> A lot of it [online training] didn't really transfer in my opinion, half of it did maybe. It gave you good guidelines, but it doesn't really stick. I'm also more of a like hands on learner so it'd be nicer to have an in person session. (Participant 7) [interview]

Another participant agrees that hands-on practice is an important way for them to get comfortable using new technology, "I really wished… just kind of have us do more hands on stuff, and kind of get the hang of it… I wish we could have more support in that way..." (Participant 12) [interview]. This is emphasized by another participant who concurs that online training provides an important foundational understanding of technology, but lacks in providing the practical skills of using technology in a nurse's role:

> Some of those online modules are a little painful to get through. But, it is nice to get that initial introduction. But, it would be nice for like… new or unfamiliar [nurses] to kind of being able to practice it a bit at the bedside... (Participant 10) [interview]

In addition to hands-on practice, participants also recognize the importance of drop-in support being available during their shift:

> …It's only kind of half an hour or fifteen minutes kind of drop in session. So we just some go, like, you know, while we're working… we went there for 15 minutes, and they will just do it right away. (Participant 9) [interview]

Moreover, when participants face challenges with technology, the expectation is for immediate, on-demand support to be available, "… there's a number that we call and somebody usually comes in, I think it's IT actually that comes and helps us and guides us through things" (Participant 8) [interview].

Having hands-on practice and on-demand support are important factors to build nurses' comfort and confidence using technology while caring for patients. Additionally, participants share that beyond adapting to the tool itself, they must adapt their practice of how they interact with technology in front of patients.

4.2.2 Navigating the relationship between patient and technology

The priority for nurses is to provide care for their patients; and while technology can assist them with that responsibility, it can take away from their direct patient care. Some participants in the focus groups believe that an overreliance on technology prevents nurses from directly interacting with patients, whereas during the interviews, participants state that the patient always comes first, and technology second. As one participant states, "…The patient comes first, of course, whatever they

need you make sure their needs are met first. And then of course, you also have to check the labs values [digital system] and all that's important, for sure" (Participant 7) [interview]. Furthermore, another participant states that technology is second to working directly with their patients, "… patients are our priority and then after we check the computer for those results, bloodwork and stuff like that..." (Participant 6) [interview].

For nurses who are newer in their role, they may experience difficulties managing their patient care while learning and using new digital tools. In this case, relying on the support of fellow colleagues is important for new nurses to learn best practices:

> It can be a little challenging… there's just so many things that we see on this unit, and they're all different from each other at times. And sometimes, you know, we don't really have an answer, or we have to just kind of work together and figure it out… it is a little challenging in terms of that, to like care for patients, and also kind of learn myself as well, because sometimes there's things that I don't know myself. (Participant 12) [interview]

Participants state the importance of working together with their peers to navigate challenges with technology. When technology fails for them, it is important for nurses to rely on their colleagues to find a solution, "Improvising. Sometimes we'll think outside of the box, we'll definitely have to support each other in that sense" (Participant 14) [interview].

For other participants, when facing challenges with technology, they explain to the patient that the technology is at fault, and proceed with providing direct care to their patient. One participant uses humour to navigate these challenges, "I usually try to make light of it like 'My God, these are new'" (Participant 11) [interview]. While another seeks to blame the technology for challenges, "Nobody likes them [digital monitors], so blame the machine and not me" (Participant 10) [interview].

In the end, the relationship between nurses and patients, as well as the relationship between nurses and fellow nurses, takes priority over the nurse-technology relationship, as there is the expectation that technology may fail them and they will need to rely on their skills and working with others to do their job.

4.3 Findings from the activities

The goal of the co-design activities was for participants to prioritize the themes that emerged from the interviews and focus groups to assess how the future design of training solutions at Fraser Health could look. After each co-design cycle, a comparative analysis was conducted between participant data and the themes to synthesize the topics into the top four learning methods. These methods are listed in order of priority, when considering the impact it has on learners against the effort it takes to participate or initiate the training:

- Hands on practice time
- Quick demonstrations while on shift
- Online learning at home
- Written how-to guides

4.3.1 Hands on practice time

Having time to practice and get familiar with new technology ranks as having the greatest impact on nurses' learning and adopting technology, while requiring a medium-to-high effort from learners. Some participants relate the positive impacts of this method as their preferred learning style "…hands on person, that's my best way of learning…" (Participant 13) [activities]. Another participant describes this learning style as helping them to better memorize processes:

> So I definitely feel like hands on practice is the most beneficial for me being able to actually do it and like follow through with the process just helps me remember better, just my style of learning things. (Participant 14) [activities]

Furthermore, another participant describes the importance of hands-on learning, while also addressing the challenge to make time for practice and to get comfortable with technology while managing their responsibilities as a nurse, "...we're probably a lot more used to hands on learning, you know, as a clinician. So, that usually stick with us better. But…making that time is very challenging to say the least" (Participant 3) [activities]. Participant 1 also describes how hands-on learning has a positive impact, but takes the most time compared to other methods as it is done individually or in small groups, whereas the other methods can be taught in bigger groups.

4.3.2 Quick demonstrations while on shift

Research participants rank quick demonstrations while on shift as the second most impactful learning method, as this provides nurses with on the spot training from peers. This method also ranks as high-effort as it is time-consuming for staff to give and receive the demonstrations. One participant describes how the method of watching a peer demonstrate how to use a tool is a relatable learning practice that nurses are exposed to while in nursing school:

> …Watch other people demo… grab someone to double assure you. That's a big one in the context of patient care to kind of see one, do one, watch one. And then definitely have like selected… pre-selected champions in unit that is not a leadership person. Like whoever that's on the floor has to be, like willing to lead it from the frontline perspective. (Participant 3) [activities]

This finding illustrates both the importance of being able to learn by doing, as well as the value of having the teacher be a peer who has relatable clinical experience. Having peers validate their learning of new technology brings comfort and confidence to nurses adopting new tools:

> "…You can utilize that person that's doing like a demonstration, they can show you how you can and then you can kind of like demonstrate your understanding with them there and validate. (Participant 13) [activities]

In addition to the value of having a peer lead the demonstration, is the importance of having quick access to someone who can provide answers to questions. When it comes to experiencing challenges with technology, one participant describes the significance of being able to get immediate support, "They'll [nurses] call a support person. Yeah, the fastest option will be always someone else" (Participant 4) [activities]. A lack of time is a recurring theme among participants that prevents nurses from being able to pay attention to, or participate in, on-shift demonstrations:

> Quick demonstrations while on shift... I know that while we're on shifts, our mind is kind of thinking of other things and quick demonstrations can be interrupted while on the unit. So just depending on how busy we are, at that time, it can be less impactful for me. (Participant 14) [activities]

This finding is consistent with Participant 1 who describes that learning is often better if a nurse comes in on their time off, as they face less anxiety about getting back to their patient or relieving their coverage person if they are attending a demonstration while on shift. So, although demonstrations on shift are a valuable way to learn, there are constraints for nurses to be able to fully participate in this method.

4.3.3 Online learning at home

Online learning in the form of e-learning courses and videos ranks third, as it provides a medium impact on learners while requiring high effort to make and participate in. Participants describe the effort it takes to complete online training as difficult as it means they have to find the time and the tools to participate in the training. As one participant describes, "the online learning at home is a little bit more difficult. And you kind of have to…figure it out yourself. Kind of more effort" (Participant 13) [activities]. This finding aligns with earlier findings from the interviews that describe the importance of collaboration and receiving support from colleagues, factors that are lost in online learning environments at home.

The final challenge with online learning relates to the discrepancy between learning something on a screen and the actual use of the tool while working. This inconsistency proves to be a challenge for nurses to effectively learn how to use a tool in their role:

> Online learning at home... [has] not been the same as actually doing it in real life. Certain things are a little bit different just from the way that the system is able to demonstrate through our home computers and how it actually does on the unit. So sometimes, there can be a bit of discrepancy there, from what I remember. And that effort is obviously just all on us because we're doing it on our own time by ourselves. (Participant 14) [activities]

4.3.4 Written how-to guides

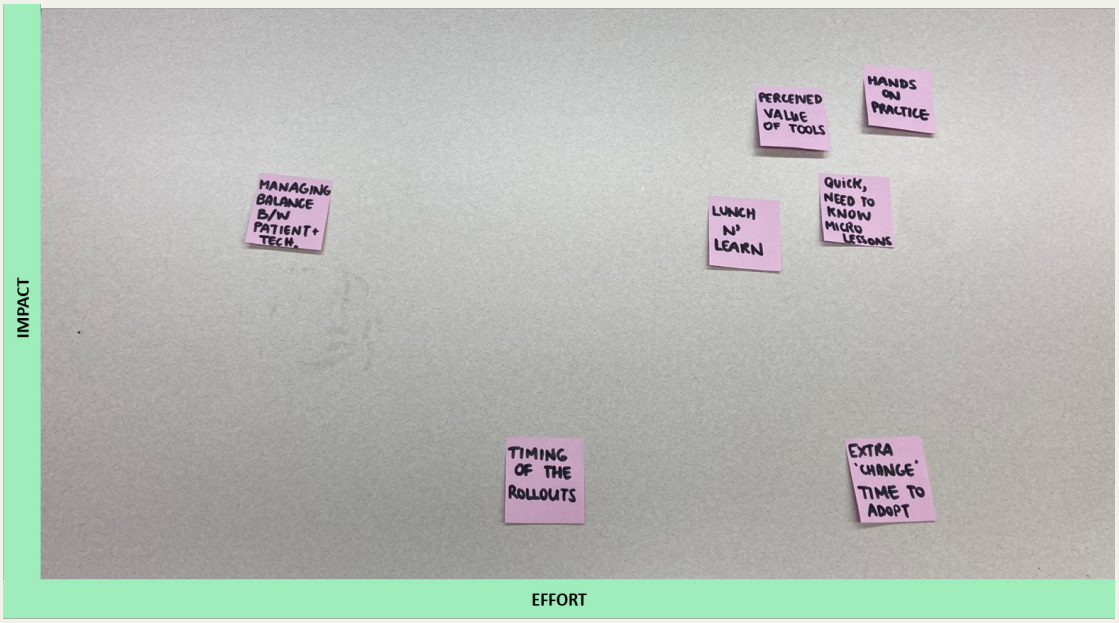
A written how-to guide provides nurses with important information about a digital tool, however ranks among all participants as having the lowest impact for learning. Many participants refer to it as a tool they use for a refresher, but not as a primary learning solution, "... I personally, just they're not very helpful, unless you already know how to do something and just need like a quick refresher" (Participant 14) [activities].

One participant described it as helpful only if it is condensed down to the most important details that a nurse needs to know, and not a big book of information (Participant 1). The solution ranks relatively low in terms of effort, where participants feel that it is easy to access these documents when they need to.

4.3.5 Co-design activity results

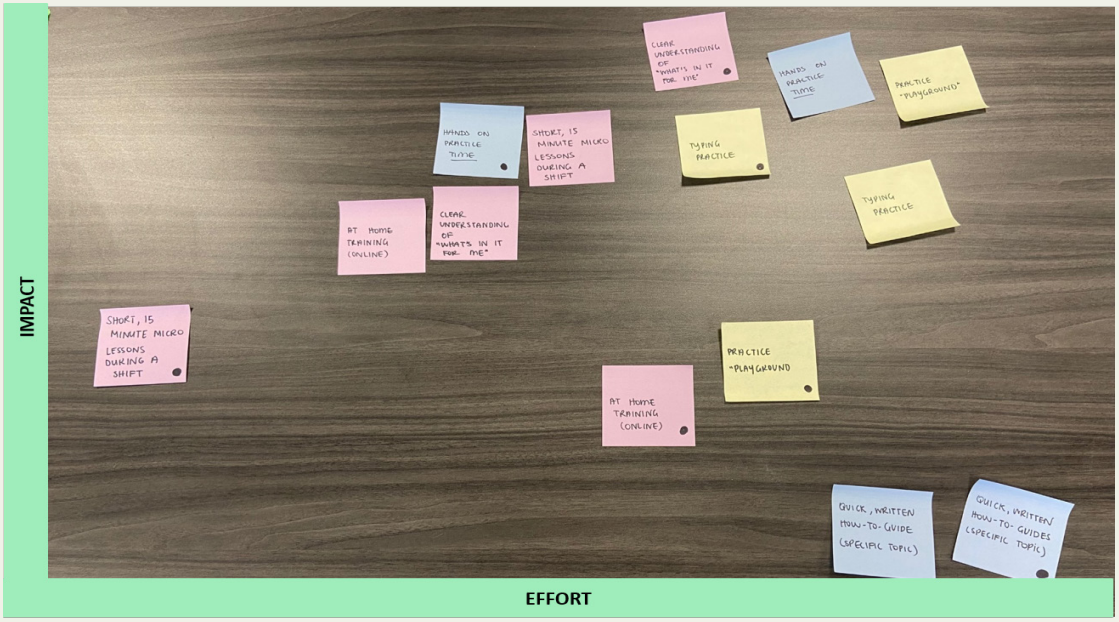
The results of the co-design activities are depicted in the photos from each session. Figure 3 was the first co-design session and had seven post-it notes for the participant to prioritize and share their experiences with. Figure 4 was from the second co-design session with two participants and there were six post-it notes each, as the results from the first session had been synthesized and reflected in the activity. Finally, Figure 5 is a photo from one of the final sessions which were held via quick, on-the-spot activities with participants during their shift. At this point, the findings had been thematically analysed to include the top four training methods to gain further insight from these participants.

Figure 3. *Impact vs Effort Activity from First Co-Design Session (own picture)*



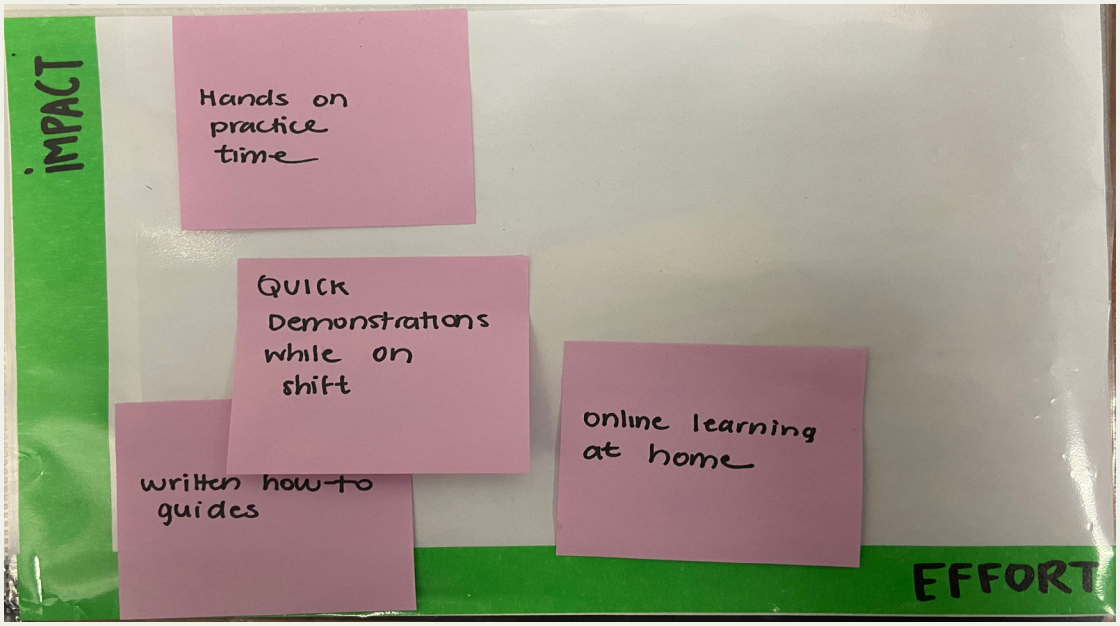
Note. The themes from the first activity were compiled during the post-focus group and interview analysis. These themes were more broad and general training elements and not specific training methods. The themes are: managing the balance (relationship and time) between patients and technology, managing the timing of new technology rollouts, providing a lunch and learn, communicating the value of tools, providing hands-on practice time, providing quick demonstrations, and providing extra time to adopt technology.

Figure 4. *Impact vs Effort Activity from Second Co-Design Session (own picture)*



Note. The themes for the second activity emerged through the analysis of the findings from the first activity and resulted in the following themes: providing short demonstrations during a shift, providing at home online training, communicating the value of new technology, providing practice time, providing typing practice, and providing written how-to guides. This activity included two participants, the black dot in the corner differentiates between each participant.

Figure 5. *Impact vs Effort Activity from Third Co-Design Session (own picture)*



Note. The themes for the last activities were synthesized from the previous activities and resulted in the final four themes: hands on practice time, quick demonstrations while on shift, online learning at home, and written how-to guides.

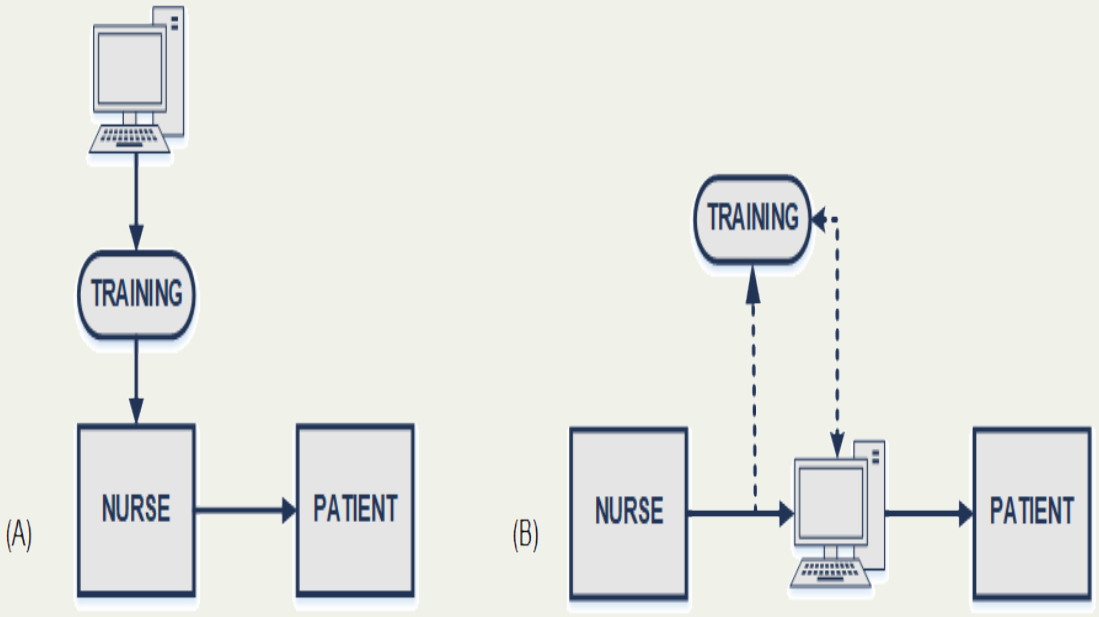
Chapter 5. Discussion

Based on the findings, the researcher proposes a theory that training for new technology should include a tangible training aid for nurses. The theory suggests that a hands-on, physical training replica of new digital tools should be available to nurses to aid in their adoption of new technology. The training aid is supplemental to formal training methods, such as online or classroom training, and focuses on providing a collaborative method to increase confidence and capability of nurses adopting technology in their practice.

5.1 Defining the relationship between nurses, technology and training

This research study sought to understand the relationship between nurses, technology and training. As gathered from the findings, a nurse's priority is to focus on their relationship with patients and the use of technology or the training for technology comes secondary to patient care. The research recognizes the importance technology has in helping nurses provide care and increasing efficiency. Thus, nurses are aware of the importance of technology adoption and training, however there are gaps between nurses feeling confident and capable to use technology in their practice. Based on the findings, the researcher created the theoretical models in Figure 6 to represent (A) the current approach to the nurse-technology-training relationship, and (B) the recommended approach to the nurse-technology-training relationship. The diagram in Figure 6 (A) represents the relationship between nurses, technology and training in common, instructivist training environments such as online training, demonstrations or written guides. This model illustrates how training is used to bridge the knowledge gap between nurses and technology, with the goal to provide nurses with the skills to use technology to provide patient care. Figure 6 (B) presents an alternative model where training and technology are embedded within the practice between nurse and patient. This method is recommended as a way to increase confidence of nurses using the tools to provide patient care.

Figure 6. *Model of Nurse-Technology-Training Relationship*



Note. Diagram (A) represents the relationship between nurses, technology and training where training is a bridge to fill the knowledge gap between nurses and technology, providing them the skills to conduct direct patient care. Diagram (B) proposes that the relationship between nurses, training and technology should happen in a cyclical process before and during patient care.

5.2 Learning to navigate challenges

An important element of training for new technology is to prepare nurses for the challenges and failures of technology, recognizing that their practice is dynamic, and training must be flexible and adaptable to their environment. The findings reveal that there is a significant need for nurses to be able to troubleshoot technology and navigate challenges as they arise while using technology. This flexibility to adapt on the spot to challenges, while providing patient care requires nurses to recognize how

technology fits into their practice and not just understand how technology works. This aligns with the findings reported by Guise and Wiig who asserted that training for health care workers is less about staff mastering new technologies, and rather about how they adapt their daily work practices to new ways of using technology to provide health care (2017). This implies the importance of focusing on how the training method facilitates this relationship between nurse and practice. Thus, a training aid that is available on-site so that nurses can consider how the tool fits into their current scope of practice and when to rely on clinical, non-digital solutions is an important consideration for the design of a tangible training aid.

5.3 Relying on peers to gain confidence with technology

Written guides and e-learning are both presented as one-way, instructivist methods of teaching that are not regarded as very impactful to nurses learning and adopting technology. Nurses do not have peers available in the learning process to relate, clarify or discuss concepts with because both methods of training are often designed for independent participation. Participants expressed that both training methods provide a generic and standardized understanding of the tool that is not always translatable to their own circumstance. Moule et al. indicate in their study that e-learning is viewed as a supplemental training tool, and the effectiveness of it can be improved through the presence of champions or super-users of the technology (2011). Research participants describe champions and super-users as fellow clinical staff who take on additional training or responsibilities to learn, adopt and 'champion' new technology in the workplace. The value of having champions or super users available is a common finding within the research.

Whether to provide support, demonstrations, or guidance while using the tools, having someone present is an important part of learning technology for nurses. This is congruent with the findings from Zittleman et al. who compared two different training models and confirmed that health

care workers who participated in the team-based in-person training responded with higher levels of satisfaction as well as self-rated their ability to understand and apply the tool higher than staff who completed online training (2020). Nurses at Fraser Health who participated in the research consistently stated that having someone present allowed them to confirm their use of digital tools, answer questions, assist them with troubleshooting or provide clarification for the use. Whether through short in-person demonstrations or time practicing using the tool with other colleagues present, they rated these methods as the most impactful.

The findings imply that nurses seek out support from fellow peers who are confident using the tool, including staff in clinical nurse educator roles, patient care coordinator roles, or fellow nurses in the same or similar roles; they did not mention seeking out support from staff in formal management or supervisor roles. This further demonstrates how power dynamics influence an individual's preference to get help from someone who is in a similar position or environment as them. The preferred method to learn is from a peer in a work environment, implying the limitations of a formal teaching environment. Participants shared that they feel stressed from being taking away from their patients to participate in on-shift formal teaching environments (class or lab). Participants also shared that they experience additional stress if they require a colleague to provide coverage for them while they attend training, implying the importance of relationships between colleagues. Thus, having the training be readily available and on-demand where nurses are present is critical.

The goal of the tangible, in-unit training aid is that it is able to be shared and discussed among colleagues. Having a tangible item means that it can be picked up, passed along, and played with in an environment of their peers so that nurses feel more confident to ask questions and discuss best practices between the tool and practice.

5.4 Increasing access to training

Training must be available for nurses when and where they are ready to learn. Research participants shared that they feel stressed or anxious leaving their patients during a shift to participate in training, which implies that under these circumstances they are not in a state of mind that is conducive to learning. Likewise, in the development of an online learning curriculum, Atack, Luke and Sanderson discovered that they must include a 'just in time' section to include key concepts and solutions that can be readily available for nurses without them completing the full training (2004), illustrating the need for concise and accessible training.

Furthermore, online training may mean that nurses have to invest their own time and coordinate their own space to participate, which may not create an accessible learning environment. Thus, a training solution must be available for nurses to engage with in a location and at a time that they feel comfortable and ready to learn. The initial recruitment process for this study proves the importance of time and place for nurses, as participants were willing to participate in on-the-spot interviews in their department wards (in-between patient care) as opposed to the scheduled focus groups that took place in a central location outside of working time. For some participants, they would be available for two to three minutes, tend to their patients, and return to finish the interview. Thus, flexibility was a key factor for having nurses participate in this study, as well as an essential consideration for designing an accessible training solution for nurses.

5.5 Designing a tangible training aid

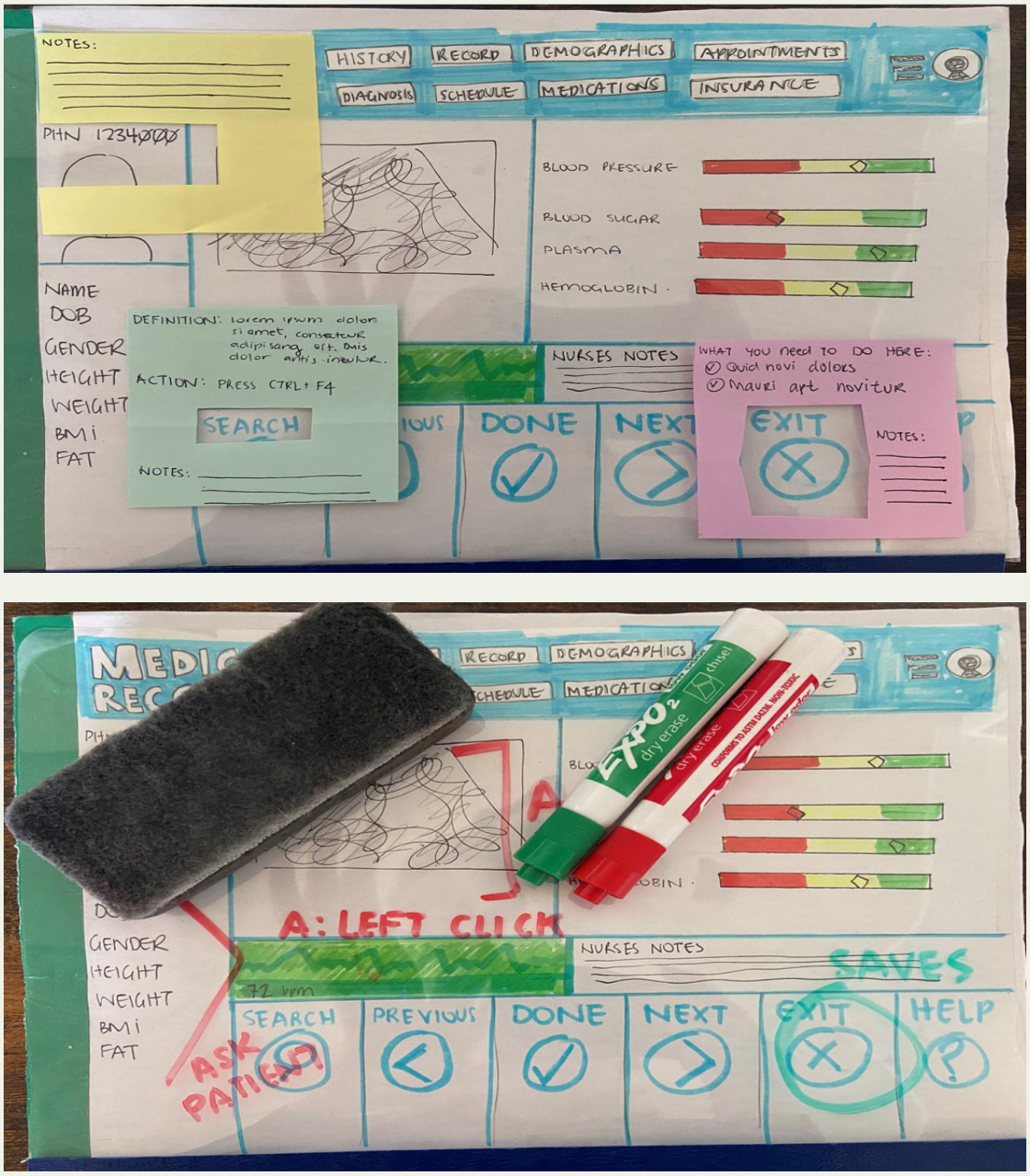
Recognizing the preferences for a learning environment that is practical, tangible, peer-supported and readily available, this theory proposes an on-site training aid that replicates the new technology and provides nurses an opportunity to play, practice and navigate the technology at a time and place best suited to them. This method of a self-guided training tool provides nurses with a sense of autonomy over their learning journey, which is an important factor in nurse job satisfaction (Campbell et al., 2020). As a result, this research proposes designing an initial prototype

of a tangible training aid to test this theory. The training aid would align with tactile learning methods and promote a multi-sensory approach for nurses.

Tactile learning is a style of teaching that provides learners with something they can physically touch or try in order to understand something (Western Governors University, 2020). Additionally, a tactile learning environment adapts to the variety of learner needs (Western Governors University, 2020), which is essential as the findings from this study depict the variability of skills and comfort using technology among nurses.

The initial prototype would be a paper-based replica of a digital tool that mimics the experience of the technology for nurses. Figure 7 illustrates an example of an early low-fidelity prototype of an electronic health record. In this prototype, it would provide different tangible tools for nurses to touch, manipulate and explore to increase their familiarity and recognition of the tool.

Figure 7. *Early Prototype of a Tangible Training Aid (own pictures)*



Note. This low-fidelity prototype of a paper-based electronic health record training aid includes dry erase markers, stickers, prompts and outlines for nurses to use to make notes, draw connections, and further their understanding of the interface for the electronic health record.

The reason for creating a paper-based model is derived from the findings from Touré-Tillery and Wang's study who concluded that the medium in which individuals use to make decisions has a significant impact on the choices they make (2022). The study indicates that when users make a choice on paper it feels more "real", more representative of who they are as a person, and are more likely to make the more responsible choice (Touré-Tillery & Wang, 2022). This study resonates with the theoretical underpinnings of Marshall McLuhan's work on communications theory and how the tool in which one uses to transmit a message carries meaning (2019). Given that a theme from the findings is that nurses feel hesitant or fearful of making mistakes while using technology, it is important to present them with an option they are comfortable and confident approaching. A tangible, paper-based training tool presents a low-barrier option to increase nurses' initial comfort and confidence engaging with a new tool. Finally, by designing a multi-sensory and tangible training aid it presents an opportunity to design for learning styles that other standard training methods exclude. Increasing the scope of which learning styles are available through training increases the accessibility of training to be inclusive of nurses who may not align with other training methods. Designing for the uniqueness of humans, is a critical part of inclusive design practice (Treviranus, 2018).

5.6 Addressing study limitations

A significant limitation in the study was recruiting a large pool of participants from across Fraser Health. As indicated in previous studies, nurses are very busy with their clinical practice and have limited time to be involved with participatory research (Atack et al., 2004). Remaining flexible and adapting the study to the availability and interest of stakeholders was important in getting the recruitment message out there. Throughout the research study, the in-hospital libraries and clinical leads proved to be instrumental in gaining access to department managers and leaders who could pass along the recruitment message. Further, it is equally important to plan for multiple visits to multiple sites, as one cannot predict how busy a hospital will be on any given day, impacting who may be available. Although the research was conducted after midnight to attempt to avoid peak hours in wards, some nights were still very busy, influencing which nurses could participate.

Interestingly, feedback from the initial recruitment campaign requested research to be conducted at additional sites across the Fraser Health region, especially those sites that were close to implementing an electronic health record tool at their hospital. The reason for not selecting these sites is to inform the training design at future sites and have time to explore options prior to the launch of the new electronic health record at their sites.

Chapter 6. Conclusion

In conclusion, the findings from this research argue the importance of designing adaptable, multi-sensory training solutions to the learning and adopting of technology tools among nurses. As identified in this study, the relationship between nurses, technology and nursing practice is an important consideration for how training can bridge the gap between patient care with technology and patient care without technology. Using paper presents a low-barrier option for nurses to engage with technology and gain confidence and comfort adapting to new technology as part of their role.

Nurses will continue to rely on formal training methods such as demonstrations, online learning, written guides and peer support to build their knowledge and capabilities of a digital tool. As described, the tangible training aid would not replace the training methods to build skills and knowledge for technology, but rather would accompany training as a method to build confidence when navigating challenges, incorporate technology in practice and collaborate with peers.

Future research should include the development of a tangible training aid to test the impacts it has on the confidence and the capabilities of nurses adopting technology. Beyond a one-dimensional paper prototype, future iterations should consider how different tactile and multi-dimensional options can be incorporated into the design of the training aid. Given the differences among nurses, ongoing recruitment and identification of partners in hospital settings is critical to testing this prototype to understand how it can fit into the scope of practice and needs of nurses.

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Appendix A. Focus group script

Note: Focus group script adjusted based on the feedback from participants during the session.

1. Please state your role, the department you work in and how long you have been in your role. You may introduce yourself using a pseudonym for the recording, if you prefer.
2. In a typical shift, what forms of technology do you use to do your work? This may include computers, laptops, smartphones, fax machines, pagers, tablets, or other devices?
3. Since starting your career as a [nurse], what new technology has been introduced in your role?
4. Thinking about the new technology that's been introduced, how did you hear about it being introduced as part of your role?
5. How did you learn how to use the technology?
6. What kind of problems have you experienced using technology in the workplace? Why do you think these problems occurred? What ways have you managed these problems or found work around solutions?
7. Where or who do you go to receive information about new technology in the workplace?
8. As technology continues to evolve and play an important role in health care, how do you see your role changing or adapting?
9. What do you consider to be the most challenging part of incorporating new technology into your role?
10. Summary question: [Insert key questions and main ideas that emerged] Is this an appropriate summary of what we discussed today?
11. Final question: Today was intended to learn about your everyday experiences learning about and using technology in your role. The purpose is to learn how that aligns (or doesn't align) with how we design education for new technology and how we can improve that experience. I will take today's findings and synthesize the key messages and during our next session, we will focus on how these experiences can be applied to designing an education framework. Are there any additional ideas or thoughts you had about this topic?

Appendix B. Interview script

Note: Interview questions were narrowed down from the focus group script after initial coding identified the top themes to be corroborated in the interview process.

1. Please state your role, department you work in and how long you have been in your role. You may introduce yourself using a pseudonym for the recording, if you prefer.
2. What digital tools or applications do you primarily use during a shift?
3. When new technology is introduced into your role, how do you hear about it?
4. What challenges have you experienced using technology? How have you overcome these challenges?
5. When new technology is introduced, how do you learn about the technology or learn how to use the technology?
6. How do you see your role changing as new technology is introduced at Fraser Health?