NURSE-CENTRED DESIGN: HOMECARE NURSING WORKAROUNDS TO FIT RESOURCES AND TREAT WOUNDS

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Abstract

In recent years the number of patients referred to home and community healthcare units are increasing. Many in this population have chronic or difficult to heal wounds. Homecare nurses provide care for these patients. The resources available to nurses have not increased at the same rate. Observations made in this study indicate that nurses have to fit resources to work around barriers to their work. This is known as a workaround. To identify common workarounds data from 6 weeks of observation was topically coded and thematically analyzed. The findings were validated using a questionnaire. The results point to gaps and limitations in access to reliable, accurate, and consistent resources, especially in work nomadic in nature such as homecare nursing. Workarounds created and used by homecare nurses enable them to negotiate appropriate fits for resources and fill in the gaps. Many of the workarounds were found to be related to computational resources. It is possible that use of these workarounds to inform new design leads to nurse-centred design. This type of design will give homecare nurses access to resources that they need while supporting their nomadic work.

Keywords: User centred design, Workarounds, Homecare, Human behaviour in design, Design methodology

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1 INTRODUCTION

Chronic wounds are wounds that do not heal in a timely manner and in an orderly reparative process to produce functional and anatomic integrity within 3 months (Järbrink et al., 2016). In Canada, depending on the healthcare setting, between 4% and 28% of patients have chronic or difficult to heal wounds (i.e. up to 100,000 patients at any given time) (Denny et al., 2014). Nurses are often the bedside clinicians tasked with managing and providing care for patients with chronic wounds (Nordheim et al., 2014). Studies show that especially in the context of homecare nursing, resources are shrinking while demands are increasing (Siegel et al., 2015). Thus, many nurses must navigate between fitting limited resources and getting their job done (Debono et al., 2013). While this type of resource fitting is shown to have negative effects such as low patient satisfaction, low job and occupation satisfaction for nurses, as well decreased patient safety and quality of care (Papastavrou et al., 2014), resource limitation is necessary in some environments such as homecare nursing (Siegel et al., 2015). Many of the resource fitting strategies created and used by nurses involve computational resources (Debono et al., 2013).

Use of health information technology (HIT) by nurses who care for patients with wounds is a recent and growing advancement in nursing (Nordheim et al., 2014). However, limited research has been carried out on the adoption of HIT in home and community settings, especially from the lens of resource fitting. Studies suggest that users develop alternative paths to an end goal when they perceive that the technology is keeping them from accomplishing their work (Debono et al., 2013). These alternative paths are referred to as workarounds (Gasser, 1986). Workarounds are common in work environments where tasks are complex, and workers need to constantly negotiate and find the best fit between different dimensions of work resources, such as activities, time, location, policies, and technology (Halbesleben et al., 2013). Workarounds are commonly identified as a form of resource fitting when nurses face resource limitations (Debono et al., 2013; Novak et al., 2013). Many of these workarounds are related to technology and scarcity of computational resources (Debono et al., 2013). In the context of technology adoption, workarounds are defined as "intentionally using technology in ways the technology was not designed for, or relying on alternatives which conflict with the formal ideology of the used technology" (Gasser, 1986) to accomplish the same end goal. Workarounds are common in many HIT implementations (Debono et al., 2013; Novak et al., 2013), however workarounds have not been studied in the home and community healthcare setting (Debono et al., 2013). The study presented here takes a holistic approach to identify the natural, human socio-cultural, and artefacts' techno-physical contextual factors (Aranda Jan et al., 2016). We identified workarounds created and used by homecare nurses, detailed their most common characteristics, and validated the results. Once identified and described, these workarounds can be used to inform nurse-centred designs for technology that are informed by the problem solving strategies of the nurses to address resource limitations (Jagtap et al., 2014).

1.1 Workarounds and Resource Limitations in Nursing

There is growing evidence that the amount of time nurses need for documentation increases after HIT systems are implemented which further strains their resources (Dowding et al., 2015). Large quantities of data are collected using HIT systems, however finding useful information that convey the patients' "story" is difficult (Clynch and Kellett, 2015). This generates dissatisfaction among nurses which leads to decreasing the intention to use, however since nurses are usually mandated to diminish or decrease use of paper and use HIT systems, nurses rely on a hybrid usage of HIT and paper systems (Dowding et al., 2015). Inaccurate and out of date patient data are some of the consequences (Dowding et al., 2015). Hybrid HIT and paper systems, are often perceived to be a manifestation of unsuccessful technology adoption (Halbesleben et al., 2013; Novak et al., 2013). Also there is a perception that inadequacies of technology lead to workarounds as a way to manage resources (Halbesleben et al., 2013). On the other hand when nurses perceive that a technology is easy to use and useful, they are more likely to be satisfied with the technology (Rawstorne et al., 2000). The purpose of this study was to identify the types and frequency of workarounds created and used by nurses in home and community healthcare as part of nurse-centred technology design.

2 METHODS

A mixed methods design was used for this study. Quantitative measurements were complemented with qualitative observations and the analysis involved achieving consensus across the research team. The study presented here has two phases: during the first phase workarounds were identified and measured, and during the second phase the results were validated.

2.1 Data Collection

As part of the first phase, observation of nurses was carried out for 6-weeks at different home and community healthcare units in metro Vancouver area. The observations involved shadowing 36 nurses for a total of 120 hours in 7 home and community healthcare units. The observation tasks included taking field notes and logging events using an activity tracking software. The majority of participant nurses were observed for a full shift (i.e. approximately 8 hours). In general, observations varied from 2 to 8 hours, but were equal to approximately 15 full shifts. During the validation phase a Likert scale questionnaire based on categories shown in Table 2 was given to 70 nurses to validate the findings from the first phase of the study. Nurses were asked to indicate their level of agreement with the identified workaround patterns, whether if they agreed that those patterns were most common, and to add any comments they might have.

2.2 Data Analysis

The observations, event logs and field notes were used to identify the types of workarounds created and used by homecare nurses. The topical codes that were used for analysis of data were adapted from the literature (Halbesleben et al., 2013; Novak et al., 2013). Qualitative data analysis software was used for the topical coding. A code was assigned to each instance of a workaround and the frequency of the codes was calculated. Then, the most frequent workarounds were categorised into themes. The workaround validation questionnaire results were analyzed using descriptive statistics.

3 RESULTS

We found that workarounds occur when nurses face barriers in finding a fit between resources that vary in availability (e.g. time, people, technology, and equipment). The observations revealed that wound care consists of: 1) the assessment of 7 types and 6 stages of wounds; 2) care planning involving 120 medical products; and 3) documenting 25 characteristics of wounds (e.g. wound measurements, wound etiology, exudate, wound bed, peri-wound skin). Homecare nurses walk or drive to the homes of multiple patients each day, which requires planning and coordinating appointments that can be unpredictable and change throughout the day.

Nurses chart patient data and communicate with other clinicians in their unit using a wound documentation system. There are seven components to the wound documentation system including the patient profile, the wound profile, wound assessment, wound treatment, a summary, data viewer, and patient administration. Usage of the system varies between individuals and across different health units. The regional health authority provides nurses with equipment including a laptop, a digital camera, and a USB dongle for Internet connection on cell phone networks. Nurses are expected to bring the equipment with them during home visits and to use the wound documentation system in patients' homes. However, nurses do not adopt this usage behaviour. Instead, nurses use the laptops as workstations at their desks and only take the cameras with them on home visits. Rather than documenting their assessments and care in patients' homes, nurses perform their documentation at the end of their workday. Documentation begins with data entry for the patient profile, if needed, and concludes with a summary of the care that they provided. Creation and use of workarounds by nurses was observed to be very common, which suggests resource limitations and barriers to nurses' satisfaction and their intention to use the wound documentation system they are provided with.

3.1 Examination of Nurses' Daily Routine

This section provides the description of a nurse's daily routine to provide context for the results. This description demonstrates how workarounds enable critical aspects of care by allowing the nurses to find the best fit among the resources available to them.

3.1.1 Working Around Resource Limitations

Although the nature of nursing work in home and community healthcare is very nomadic, nurses spend almost as much time behind their desk as they spend time with patients. Figure 1 illustrates the typical set up of a nurse's desk.

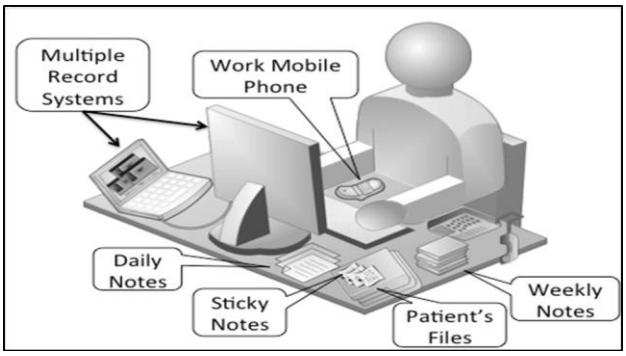

Figure 1. Resources and tools available to homecare nurses on their desk.

Limited resources such as unreliable Internet connections, the added physical burden of carrying a laptop, and mismatches between the system and nurses' workflow caused nurses to not to take their laptops to patients' homes. Instead, nurses use paper notepads to write items that need follow up or reminders. This note writing task is done in the morning before starting patient visits. Notes are written based on patients' paper and electronic records. More notes are added later after collecting the relevant data and making updates during the home visit. The paper notepads are used as a data source to document patients' wounds. Some nurses use a second paper notepad to manage weekly or monthly tasks. The patient files typically contain a collection of printouts from a patient's electronic record, as well as faxes, sticky (post-it) notes, hand written notes, and even wound care supplies/packaging that are used as reminders for the next patient visit. In practice, the paper patient file compensates for resource limitations and provides the mobility that nurses need for their work. Using the patient file, nurses can be on the move and have an overall view of the patient's status in one place. One of the nurses noted, "it's all there in front of you!" Annotations made in a patient's paper file are used as resources to highlight details about the case. Handwritten and sticky notes summarize patient data or communicate asynchronously with nurses who are visiting the patient in the future, specifically to remind others about an item that needs to be addressed. Nurses spend several hours of their day transferring data collected in paper systems to electronic records systems. It is a common practice to use paper and electronic records systems as a hybrid system, regardless of the fact that the electronic records systems are meant to replace much of the paper systems; in other words, to go "paperless". To further elaborate on the context of nurses' work outside of their office a nurse's workday is reconstructed based on the events observed during data collection. Nurses start their work at 8:30 AM and finish at approximately 5:00 PM. The nurse drives their car and visits a total of 4 patients within the area covered by the community health unit. Figure 2 and Table 1 exhibit this reconstruction.

At the beginning of the day nurses plan and coordinate their patient visits based on available resources and factors such as, distance from the office, schedule of a colleague (typically a wound clinician) for a joint visit, personal preference, patient's preference, parking, and traffic considerations. The nurse might drive back to the office and start their patient documentation depending on the available time between the end of one visit and the start of the next visit. Table 1 shows one example and the frequencies of workarounds for each location during the daily travel of the nurse. The duration of patient visits varies depending on the nurse's workflow and the patients' cases.

At the start of work day the first task a nurse might do is to gather supplies and collect information about the scheduled patients for that day. In collaboration with nurses, a clinical coordinator schedules the patients. In the example here, the nurse was already familiar with some of the patients' cases since she had reviewed their records the day before, so in her morning routine she spent less time reviewing patients' electronic records. After collecting the patients' files and gathering the wound care supplies from the supply room (8:30 AM office visit), she drives to see two patients (patient 1 and then patient 2), the nurse is early for the next appointment so she drives back to the office to document her

assessments and care provided to the patients she visited in the morning (10:45 AM office visit). After documenting some patient data the nurse drives to the next patient's home (patient 3). After visiting the last patient (patient 4) the nurse spends the rest of the work day on patient documentation. The constant use of workarounds indicates the substantial amount of resource limitations and barriers that homecare nurses face in their work. These observations show that most commonly nurses have to fit resources and overcome barriers while using the electronic records systems at their office in order to coordinate, manage, and document their patients' cases.

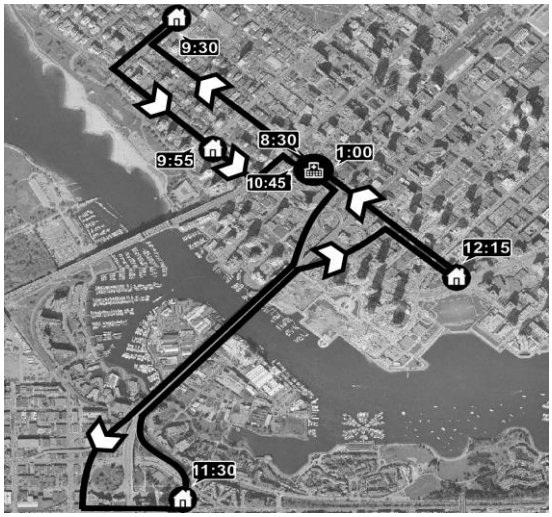

Figure 2. A nurse's route to visit patients at home (Government of British Columbia, 2016).

Table 1. Details of workarounds in a daily routine of a homecare nurse.

Time	Workaround example	n	Location
8:30 AM	Summary sheet on the patient file to prep supplies	3	Office
9:30 AM	Leaves extra supplies	2	Patient 1
9:55 AM	Asks about the dressing, to see why it was used	4	Patient 2
10:45 AM	Sticky note to update the care plan in the patient file	10	Office
11:30 AM	Will use a product next time since she didn't bring it	5	Patient 3
12:15 AM	Writes wound measurements on travel notepad	4	Patient 4
1:00 PM	Copy and pastes from one electronic records system to another	21	Office
	Total	49	

3.2 Workaround Categories in Home and Community Nursing

Topical codes used for identifying instances of workarounds were adopted from Novak et al. (2013), including codes for two categories of workarounds: system and process workarounds. System workarounds are described as, using the technology (i.e. the system itself) to work around a barrier to work and primarily include adaptation and appropriation of technology. Process workarounds are described as, using manual alternatives to work around a barrier to work, such as use of paper systems, interpersonal communication, as well adaptation and appropriation of resources to overcome barriers. These workarounds reflect the work routines, priorities, trade-offs, and problems solving strategies, however system workarounds reflect the design, selection, and implementation of technology (Novak et al., 2013). A total of 464 workarounds were identified during the 15 shifts, or approximately 31 workarounds per shift. Most were process workarounds (n=331; 71%) with only 29% (n=133) were system workarounds. Of these, most were caused by barriers related to technology (n=372; 80%). This suggests that technology adoption was less successful and it also may suggest a manifestation of rejection of the technology itself by nurses. On the other hand use of technology in ways that are not intended (i.e. via these workarounds) might be considered instances of appropriation, which is viewed in a positive light by the Human-Computer Interaction community (Anacleto and Fels, 2013). An example of appropriation as a workaround is when one system is used to work around barriers caused by another system. System and process workarounds are often evidence of problem solving and resource

management strategies and are creative in nature. System workarounds in the form of appropriation or adaptation point to possible solutions that can be designed to solve technology and resource limitations. Process workarounds show creative ways in which nurses solve problems despite limited resources; this is particularly important given that lack of availability of resources in a patient's home. Mental power is another resource that nurses need to preserve in order to accomplish their work and it is possible that process workarounds play a substantial role in lowering the mental load of nurses by providing easier ways to negotiate a solution to get their job done. Several system and process workaround attributes were identified including tasks, actors, resources, time, location, and outcomes. Based on the workaround attributes they were further subcategorised. These subcategories are discussed in the next section.

3.2.1 Workaround Subcategories

Analysis of workarounds based on common attributes revealed seven subcategories. These subcategories emerged as themes based on common actions carried out, people involved, resources used, time of actions, location of actions, and the outcomes of the workarounds. The seven subcategories of workarounds include, pre-emptive information use, preventive information use, paper system use, appropriative system use, appropriative resource use, adaptive system use, and adaptive resource use. See Table 2 for definitions and examples of the workaround subcategories. These subcategories exist when barriers to nurses' work prevents them from getting their job done.

Table 2. Subcategories identified based on common workaround instances.

Pre-emptive information use (n=98, 21%)
Description: when a nurse provides cues (e.g. verbal, in writing, use of specific clinical supplies, data entry), informing the need to complete certain activities and preempt or reduce occurrence of future workarounds. It can be either of system and process workarounds.
Example: A nurse says that based on the electronic records of a patient she creates a paper cheat sheet as reminder for when she visits the patient.

Preventive information use (n=31, 7%)
Description: when a nurse provides cues (e.g. verbal, in writing, use of specific care supplies, data entry) informing the occurrence of barriers to activities, their workarounds, and the need to prevent risks associated with those workarounds. It can be either of system and process workarounds.
Example: changing the care plan and confirming with the wound clinician at later times.

Appropriative system use (n=35, 8%)
Description: a system workaround when a nurse uses a system to complete activities in which the available system is not intended for completion of those activities.
Example: use of the wound photo component to document use of care supplies.

Appropriative resource use (n=38, 8%)
Description: a process workaround when a nurse uses resources to complete activities that the resources are not intended for completion for those activities.
Example: a nurse uses her personal smart phone to take photos of wounds.

Adaptive system use (n=65, 14%)
Description: a system workaround when a nurse uses a system for the intended activities but in unintended ways to complete those activities.
Example: a nurse says they might chart some information in multiple systems so it cannot be missed.

Adaptive resource use (n=38, 8%)
Description: a process workaround when a nurse uses resources for the intended activities but in unintended ways to complete those activities.
Examples: a nurse leaves extra supplies with the patient, or in her car.

Parallel system use (n=159, 34%)
Description: when a nurse uses more than one system for the same intended activities for those systems, and in the intended ways for those systems, to complete the same activities. It is often a process workaround.
Example: a nurse looks at the sticky note on the cover of the patient's paper record with the summary care plan on it and packs care supplies (parallel paper system).

The local health authority in which this study was carried out initiated the transition from paper to electronic records almost 10 years ago, however substantial work continues to be done using paper systems. Based on the data collected in during our study, this was consistent across participants with varying technology use experience and age. Increase in workload for nurses is a direct implication of mixed use of paper systems and electronic systems. Nurses with many years of experience noted during the study that they spent less time on patient documentation and more time with patients when only paper records were required. As an example, the nurses noted that the number of patients that they are able to visit now has decreased. The observations also indicated that all participating nurses return to their office 2 to 3 hours before the end of their workday to transcribe their paper records into the electronic records system. Meanwhile, the resources available to nurses remain the same even as the population that they provide care for is rapidly growing, which is due to recent initiatives for discharge of patients from acute care to home and community care in shorter timeframes.

The human element plays a key part in the resource appropriation subcategory. Many nurses gain access to resources such as information and expertise through their colleagues. In other words, the persons with whom nurses work or provide care to are also key resources. In many cases, a nurse might ask a patient or their family about the last nurse visit or recent changes in their care plan. This is a workaround to overcome limitations in accessing electronic records at the bedside. The prevalence of adaptive system use indicates that it is possible that nurses have concerns regarding the reliability of patient data in the electronic records system. Data from the observations showed that when nurses felt they could not rely on the patient data provided in the electronic record system they did not fully follow the preferred or the intended method of use for a component in the system. For example, nurses frequently reported the need to double or triple chart in order to make sure that reliable data were recorded and was available for future use by colleagues or themselves. In another example, a nurse might classify a cluster of very small wounds in close proximity of each other as one wound. This occurred when a nurse felt that documenting a cluster of wounds as one wound was a better representation for the purpose of assessment, especially since the electronic records system does not provide an option to document a cluster of small wounds. In this case nurses needed to adapt in order to make use of the technology resources available to them.

A closely related subcategory of workarounds is appropriative system use. During the study this subcategory of workarounds was observed less commonly, however it is a well-studied category of user behaviour in human-computer interaction (Anacleto and Fels, 2013). Appropriation is closely related to adaptation, their main difference being that appropriation is to use technology or resources for an entirely different purpose than what they are designed and intended for whereas adaptation is the using the system in an unintended way but for the purpose it was designed for. As an example, a nurse brings several sizes of wound wrapping supplies with her to the patient's home, since there is no option available to select a size for that specific wound wrapping supply in the electronic records system. To appropriate, the nurse enters the size of the supply in the free-text components of the electronic records system, however that component is intended to report patient progress. As a way to limit resource waste nurses also might put the extra supplies that they carry to patients' homes in sealed bags, then they can return the unused supplies to the supply room. Otherwise unsealed supplies that are taken out of the supply room are considered unclean and cannot be returned. The identified subcategories of workarounds were validated in a second phase. The next section discusses the validation results.

3.3 Validation of Workaround Subcategories

In a follow up study, the categories shown in Table 2 were validated using a questionnaire. Respondents were provided with the name and definition of each subcategory, and rationale for and examples of the subcategory were provided. Respondents were asked to answer to two questions on a 5-point Likert scale where 1= strongly disagree, 3 = neutral, and 5 = strongly agree, one open-ended question. The two questions for each subcategory were: Q1: I have used <insert subcategory> when problems with technology, equipment, rules/policies, people and work processes prevent me from completing my task; Q2: <insert subcategory> are common in home and community healthcare. A third question provided a free text comment box and asked: Is this category named correctly? How would you change its name? (Q3). Of the 70 questionnaires distributed to home and community healthcare nurses 58 were completed (83% response rate). All of the workaround subcategories received a score higher than 3 (see Table 3) indicating that all subcategories were confirmed to be workarounds used by nurses who were not in the first phase of the study. The participants gave the highest scores for the subcategories pre-emptive information use, paper systems, and adaptive resource use indicating that these are the most common

subcategories. One participant suggested another name for the pre-emptive information use subcategory was “FYIs” (for your information).

Table 3. Descriptive statistics of the validation questionnaire for workaround subcategories (sd= Standard Deviation).

	Pre-emptive info. use	Preventive info. use	Parallel sys. use	Appropriative syst. use	Appropriative resource use	Adaptive system use	Adaptive resource use
Q1,Mean (sd)	4.40 (0.9)	3.48 (1.3)	4.21 (1.1)	3.65 (1.2)	3.48 (1.3)	3.77 (1.3)	4.23 (0.9)
Q2, Mean (sd)	4.53 (0.6)	3.66 (1.2)	4.37 (0.9)	3.82 (1.1)	3.45 (1.5)	3.82 (1.3)	4.26 (0.9)

A great number of disposable paper scraps are used to create prompts and remind nurses about tasks that they are asked to carry out. In fact, many nurses prepare notes that list the activities that need to be done for their daily patient visits as prompts to themselves. They prepare these notes at the start of the day, before home visits, based on other notes, the patients' files, patients' electronic records, and information received from colleagues. Some nurses mentioned that these notes are their “cheat sheet” to remind them of activities that they need to carry out for multiple patients who they will visit during the day. The pre-emptive information use subcategory allows nurses to compensate the lack of support in the electronic records system for resources that they need during home visits.

The primary activity of the paper system use workaround subcategory is for care planning and patient documentation; hence, accuracy and consistency are important factors in using this workaround. Paper system use happens in parallel to use of the electronic records system and is more apparent when patients with chronic conditions accumulate records from various providers in the healthcare system. Nurses do not always have access to all of the electronic records systems where patients' information reside, for this reason they have to obtain the information within those records through staff in other parts of the healthcare system who do have access to the patients' records. This often is in the form of faxed records which will be added to the patients' files. The prevalence of this subcategory of workarounds suggest that system integration remains a complex issue in this healthcare setting, and nurses are facing greater challenges to get their job done because of this issue. For example, some participants noted that access to records of patients coming from another health authority is limited, so they have to “hunt down” printouts and faxes of patients' records in order to get a better picture of the patient’s condition. In other instances, nurses might place sheets of paper on the cover of the patients’ file to summarize patients' information from various sources. This is referred to as the, “convenience chart” and is used to communicate and access the summary information, as well as to document additional information from the patients' visits. The prevalence of paper systems, confirmed by nurses' high scores in the validation phase, also indicates the amount of additional work that nurses do to keep both the electronic records and the paper records accurate and up-to-date. It is possible that this is the greatest strain to the available resources for nurses, as they spend equal or greater amount of time documenting and updating patients' records than they spend time providing care for patients.

According to the questionnaire respondents, adaptive resource use was one of the most frequently observed subcategory of workarounds. For instance, packing extra supplies before the patients' visits, and leaving extra supplies at the patients’ homes or in nurses’ cars. These instances of adaptive resource use ensured that nurses were not “caught out without supplies”, as one participant stated. Participants noted that taking these proactive steps allows them to compensate for the unreliability in data on patients’ electronic or paper records. It was also noted by participants that they like to be prepared for unpredictable situations ahead of time. For example, when the patients' care plan has not been updated recently and nurses expect that they might need resources different than those required based on the records. Hence, they have to adapt their resource use to account for any changes that might have occurred, otherwise there can be a chain of delays to the treatment that patients need caused by unreliable information in records and lack of appropriate resources on the patients' bedside. These workaround themes as strategies to deal with resource limitations can be used to inform design of systems that support the needs of nurses in their work to provide homecare for patients.

4 USE OF WORKAROUNDS TO INFORM DESIGN IN HOMECARE

As stated earlier, nurses are nomadic workers and some of the workarounds identified in this study are likely resultant from lack of support for nurses’ nomadic work and communication that is required

between nurses while they are visiting patients' homes. The importance of this issue is highlighted in the literature, which points out that nomadic work requires accommodation and support by technology (Mark and Su, 2010). In this study, it was likely that the current electronic records systems do not accommodate and support nurses in their nomadic work as evidenced by the prevalence of the pre-emptive information use workaround subcategory. Lack of support for nurses' nomadic work forces them to rely on resource fitting such as using hybrid (i.e. paper+computer) systems, mixing, complementing and at many times repeating work done using paper systems which are easy to use and useful for nomadic work.

While some research groups identify workarounds as being problematic (Halbesleben et al., 2013), others note that users' creative strategies to address resource limitations should be considered during design, and that can lead to a user-centred system, and prevent a user-hostile system as result of a designer-centred approach (Koopman and Hoffman, 2003). A recent trend is positive views towards workarounds (Novak et al., 2013; Park et al., 2015), in which workarounds are found to enable the execution of patient care, and necessary at times, despite their potential to compromise care. When looked at from the perspective that workarounds can be used to inform design, the findings from this study suggest that workarounds have been created by nurses to fit resources, and compensate for limitations in homecare nursing, in order to enable patient care.

It is possible that the nomadic nature of this type of nursing work might be similar to other types of nomadic work. Design informed by these workarounds may support problem solving strategies, and increase technology adoption. It is possible that design could be informed by mapping the workaround subcategories to concrete design principles, while taking into account the attributes of the workarounds. Many of participating nurses perceive the current electronic records systems as less easy to use or less useful. However, the hybrid use of the electronic records systems and the workarounds fill the gap between the nurses' frame of work and the systems' frame of work (Novak et al., 2013). Hence, the dimensions of usefulness and ease of use where these gaps exist can be the links in the mapping that may connect workarounds to design principles. There is already a large body of work focused at designs that use various dimensions of usefulness and ease of use (Holden and Karsh, 2010). The next step is to use the existing models in these designs to identify mapped design principles that can fill the gaps where workarounds are intended for. In homecare, this leads to a nurse-centred design. A nurse-centred design will enable homecare nurses to be mobile while having reliable, accurate, and consistent access to resources. The mapped design principles informed by workarounds were evaluated in iterative exploratory and experimental prototyping sessions with participation of homecare nurses, and the results are reported in another venue (Al-Masslawi et al., 2017).

5 CONCLUSION

The increase of the population that receives medical care at home puts a strain to the already resource-limited healthcare system. Homecare nurses, as the primary care providers for patients at home, are facing challenges to carry out activities required to provide the appropriate care that the patients need. When there is a mismatch between what resources are available to homecare nurses and their need to get their job done they create and use workarounds. This study identified and validated these workarounds. The most common of the identified workarounds are created and used by the majority of homecare nurses to negotiate a fit among the resources available to them and increase reliability, accuracy, and consistency in their work while being mobile. Literature suggests, and our study supports, that these problem-solving strategies employed by users to overcome resource limitations and barriers are valuable to user-centred design. They point to gaps in ease of use and usefulness of current designs. Future work to identify mappings that link common workarounds to existing design principles may lead to new nurse-centred designs that support homecare nurses in their resource limited and nomadic work.

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