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On Usefulness in Mandatory Healthcare Settings

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Completed Research Paper

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Abstract

This paper explores usefulness in mandatory healthcare settings. Building on previous research and interviews with all categories of users of a Patient Data Management System (PDMS) designed to replace all paper documentation in an intensive care unit we suggest that it might be appropriate if questionnaire items concerning usefulness (a) not only measures benefits for the individual person and (b) are contextualized which would make it easier for staff to relate to the items.

Keywords: belief, usefulness, measurement, healthcare.

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Introduction

Usefulness has proven to be a central construct in cognitive models within organizational IT due to evidence of its effect on intention to use and satisfaction (Davis et al. 1989; Bhattacherjee 2001). Some 30 years ago, Davis (1989) constructed and validated questionnaire items for measuring usefulness, which have since been cited more than 30 000 times. These classic items have been used to measure usefulness in different areas within the IS field (Susarla et al. 2003; Wixom and Todd 2005) in both voluntary (Bhattacherjee 2001; Dishaw and Strong 1999) and mandatory contexts (Staples et al. 2002; Brown et al. 2002). Davis' (1989) items are well validated but the usefulness construct and related questionnaire items were created when IT was intended to improve user productivity and performance. Although IT is indeed still used to improve user productivity and performance (e.g. office software) many contemporary IT applications are foregrounding other aspects, such as communication, collaboration and meaning making (Bhattacherjee and Barfar 2011; Aakhus et al. 2014).

Several studies involve the usefulness construct in healthcare contexts where voluntary adoption of Electronic Health Records (EHR) is the most common (Häyrinen et al. 2008; Uslu and Strausberg 2008). The healthcare context differs from many other organizational contexts with its 24 x 7 nature, evidence based practices and focus on patient safety (Ramanujam and Rousseau 2006). Davis (1989) classic items have been used to measure usefulness in this context (Wilkins 2009; Vathanophas and Pacharapha 2010) but additional, more healthcare specific items have also been developed (Mettler 2012; Gagnon et al. 2014).

Since there are few studies of mandatory implementations and few studies focusing on the usefulness construct, this paper takes an exploratory approach through observations and in-situ interviews with future users of a mandatory Patient Data Management System (PDMS) implemented in an Intensive Care Unit (ICU) at a major Swedish hospital to further investigate which items are relevant when measuring usefulness in this context. A PDMS is designed to automatically retrieve data from bedside equipment at critical care units and present these in a structured format to improve data manipulation and interpretation. Such systems have the potential to replace all paper documentation in an ICU.

Our research question is thus: "How can usefulness be meaningfully measured in mandatory healthcare settings?"

The contribution of the paper is a problematization of the usefulness construct in mandatory healthcare settings and a suggestion for questionnaire items based on how users attach meaning to the usefulness construct. It should be noted that we are not intending to engage in a quantitative vs. qualitative or positivist vs. interpretivist discussion but rather embrace the notion of multimethod and multi-paradigm research (Mingers 2001; Venkatesh et al. 2013; Ågerfalk 2013) in line with recent calls for more elaborate contextualization of findings (Te'eni 2015).

Related literature on usefulness

The term usefulness (in the context of information systems) originates from the Technology Acceptance Model (TAM) (Davis et al. 1989), in which usefulness is defined as, "*the degree to which a person believes that using a particular system would enhance his or her job performance*" (Davis 1989, p. 320). Table 1 shows questionnaire items formulated by Davis (1989) that have been used to measure usefulness within different cognitive models such as TAM (Davis et al. 1989), Unified Theory of Acceptance and use of Technology (UTAUT) (Venkatesh et al 2003), Expectation Confirmation Theory[1] (ECT) (Oliver 1980) and

[1] Also called Expectation Disconfirmation Theory (EDT).

IS continuance (Bhattacherjee 2001). UTAUT names the construct performance expectancy and ECT names it expectations, but since these constructs have been largely measured using Davis (1989) items we include them when referring to usefulness in this paper. Davis' (1989) items are formulated in general (decontextualized) terms, which makes them usable in different areas (Verhoeven et al. 2010; Wixom and Todd 2005) and in different temporal stages (Taylor and Todd 1995; Venkatesh and Goyal 2010). More specific items may, for instance, not be applicable to pre-implementation beliefs (Davis et al. 1989) where users may not have adequate prior experience or knowledge to form concrete beliefs (Khalifa and Liu 2002) or to relate to more specific items (Bettman and Sujan 1987). Davis (1989) questionnaire items have also been used in both voluntary (Bhattacherjee 2001; Dishaw and Strong 1999) and mandatory contexts (Staples et al. 2002; Brown et al. 2002). The widespread use of the construct usefulness, especially for organizational IT, is due to evidence of its effects across all temporal stages of IS use (Davis et al. 1989; Karahanna et al. 1999) and the fact that it is well validated (Davis 1989) and tested in many studies.

Table 1: Davis' questionnaire items for usefulness

Using [system] would improve my performance.
Using [system] would increase my productivity.
Using [system] would enhance my effectiveness.
I would find [system] useful in my job.

Three main categories of studies measuring usefulness in a healthcare context emerge from the literature where most previous studies involve voluntary contexts and the majority use TAM or UTAUT. The first category is represented by articles that use Davis (1989) original items (Wilkins 2009; Vathanophas and Pacharapha 2010) or with small alterations or additions (Ortega and Román 2011; Hewitt 2009) while the second category only states that already validated items were adapted without reporting the actual items (Liu et al. 2015; Nov and Schecter 2012). The third category use items that significantly differ from those constructed by Davis (1989), such as avoiding duplication of examinations (Gagnon et al. 2014) or improve governance and trust (Mettler 2012). Table 2 shows some examples of items from the healthcare context (only items that differ from those in Table 1 are shown in Table 2).

Table 2: Examples of questionnaire items concerning usefulness in healthcare

Questionnaire item	Source
[system] could improve the quality of care that I deliver	Chismar and Wiley-Patton 2002
Using [system] gives me greater control over my work	Hewitt 2009
If I use [system] I will increase my chances of getting a raise	Holtz and Krein 2011
Using [system] will increase information quality (e.g. consistency, completeness, traceability)	Mettler 2012
Using [system] in my job would enable me to assess back shape/posture more accurately	Schaik et al. 2002
Using [system] allow me to accomplish more work than would otherwise be possible	Aldorasi 2003
Using [system] would enhance my effectiveness in my job (e.g., better accuracy and reliability of diagnostic and therapeutic procedures)	Ortega and Román 2011
Using [system] will facilitate communication of information between various care providers	Gagnon et al. 2014

Comparing Tables 1 and 2 reveal that some items are contextualized versions of Davis (1989) items, such as (1) *[system] could improve the quality of care that I deliver* (Chismar and Wiley-Patton 2002) and (2) *Using [system] in my job would enable me to assess back shape/posture more accurately* (Schaik et al.

2002). These conform to Davis' (1989) definition of usefulness that the system could enhance the individual person's job performance where the first (1) is general and could be applied to different areas within healthcare (improve quality of care) and the second (2) is more detailed (assess back shape/posture). The drawback of more detailed items is that they can be hard to reuse between staff categories and areas within healthcare. Other items include benefits beyond the individual user, e.g. *Using [System] will increase information quality* (Mettler 2012) and *Using [system] will facilitate communication of information between various care providers* (Gagnon et al. 2014) where benefits for others such as the whole organization is included. Here we can also see a difference between beliefs towards features of the system (increased information quality) and beliefs toward the consequences of the features (improved communication) where most items measures the latter (including Davis' (1989) items). There are also items such as *Using [system] gives me greater control over my work* (Hewitt 2009) or *If I use [system] I will increase my chances of getting a raise* (Holtz and Krein 2011) that differs from Davis' (1989) items but are still individual and not tied to the context of healthcare. Increased chance of getting a pay raise is clearly linked to voluntary settings and would not be relevant in a mandatory context where everyone has to use the system.

Davis' (1989) items are well validated in the literature. The usefulness construct is defined and several questionnaire items are evaluated in steps to find items that form a clear construct, are closely linked to the definition of the construct and are not linked to other constructs (in this case ease of use). However, as mentioned above, the usefulness construct and related questionnaire items were created when IT was intended to improve user productivity and performance, which is no longer always the ultimate objective (Bhattacherjee and Barfar 2011; Aakhus et al. 2014).

Studies within healthcare that do not use Davis' (1989) items either state that their items were developed using guidelines (Dixon and Dixon 1994; Kok et al. 2011), reworded or adapted from validated scales (Archer and Cocosila 2011; Ortega and Román 2011), based on previous studies which have used and validated the items (Mettler 2012; Morton and Wiedenbeck 2010) or do not discuss the choice of items (Handy et al. 2001). Although several of these studies (Morton and Wiedenbeck 2010; Archer and Cocosila 2011) do not show any statistics for the reliability and validity of constructs, most of the articles (Aldorasi 2003; Gagnon et al. 2014) report that usefulness was a statistically reliable construct. Ortega and Román (2011) and Gagnon et al. (2014) also report high loadings for all questionnaire items within the usefulness construct. While the high loadings of the items indicate that there is high validity they do not report how the items loaded on other constructs. All factor loadings are however reported by Mettler (2012) and Kok et al. (2011). Although all four items in Mettlers' (2012) study have high loadings on the usefulness construct, two of the items have even higher loading on other constructs and the other two have almost as high loadings on another construct. Kok et al. (2011) do not report the actual items but their factor analysis shows that their seven items regarding usefulness have their highest loading spread out across four different constructs.

There are also studies that more broadly investigate beliefs towards technical systems in healthcare. Ayatollahi et al. (2009) used interviews while investigating physicians', nurses' and administrative staff's beliefs towards computer based records in general (no system was planned to be implemented) and found that beliefs towards usefulness included avoiding duplication, increasing the speed of processes, facilitating work, improving access to patient notes, improving clinical decision-making, improving the legibility of writing, reducing clinical errors, and providing accurate data. The interviewees main concern was the transition from paper based records to computer based records. Gans et al. (2005) used surveys to inquire perceived benefits of using EHR and found that the most important benefits were improved access to information, improved workflow and improved patient communication. It should be noted that the questions were formulated as benefits to the practice and not the single user. Shaw and Manwani (2011) interviewed physicians about their beliefs towards their EHR and found that the most important benefits were better organized information, template so no important questions or data was forgotten, better generated information for patients (they can compare their results to ideal) and legibility (everyone can read the notes).

From a literature review on technology acceptance in healthcare Fitterer et al. (2011) develops a taxonomy for values that are relevant for health information systems. They do not propose specific questionnaire items but instead factors such as information quality that is comprised of information availability,

information validity, ability to exchange information and access to information. The other relevant factor is health outcome which is comprised of healthcare effectiveness and health care safety.

Research setting

Data collected for this study is part of a larger mixed methods study of the implementation of a PDMS across all surgical, postoperative and intensive care units (ICUs) of a major Swedish hospital. The study was conducted at an ICU that served as a pilot unit in the PDMS implementation. They were included because they have most of the technical equipment used across the hospital and also had expressed an interest in becoming a pilot unit. The implementation at the ICU was originally planned for January 2015 but was postponed twice and implemented in October 2015.

Usage of the PDMS was to be truly mandatory where users would have to continuously use the system both to perform their own work and to enable their colleagues to perform their work. Mainly three categories of staff that worked in the pilot ICU were going to be affected by the PDMS: anesthetic physicians, intensive care nurses and intensive care assistant nurses (no academic post-secondary education). Some of the nurses had experience from Norwegian hospitals where a previous version of the same PDMS was used.

The project group responsible for the pilot implementation consisted of staff from mainly the pilot ICU but also staff from other units at the hospital as well as from the internal hospital IT department who worked together with the international company that delivered the PDMS. While the software configuration of the PDMS was performed away from the units, the hardware setup (such as wiring and installation of new monitors and displays) was done in parallel at the units and made it possible for the staff to get acquainted with the technology.

ICUs and surgical units have particular characteristics that make them different from general wards since patients often linger on the verge of stability. Since information about the patients might become vital at any point, any changes to the current work practice must be carried out with precaution. The hospital work context is also different from many other organizational contexts because of its 24 x 7 nature and since it is highly professionalized, evidence based and hierarchical with a strong focus on patient safety (Ramanujam and Rousseau 2006).

Method

Because, the goal was to explore users' contextualized beliefs regarding usefulness towards a system we adopted a qualitative approach to data collection that involved observations and in-situ interviews. The staff that was interviewed and observed in the study were primarily selected for being deeply involved in the implementation and thus had an informed understanding of the issues at stake. They also represented a wide variety of perspectives and covered all relevant categories of staff. Staff with strong opinions and that were believed to have an influence on others were chosen. Some of these were involved in the configuration project and some had previous experience with similar systems.

Data collection

Data collection was performed by the first author. Since he had no deeper knowledge or experience of healthcare, observations were vital for understanding the settings and enabled the author to ask relevant follow-up questions and to understand and analyze the recorded interviews. Shadowing (Czarniawska 2014) was used for the observations where clinical staff was followed during their shift and their actions observed and field notes taken. Observations included all three categories of staff in order to get to know the setting and different work routines. The researcher often asked the shadowed staff why different actions were performed to get a better understanding of the work context and role of different categories of staff. The observed staff were all used to people following them around since different types of observations are common within healthcare and healthcare education.

The researcher had to be dressed similarly to the staff that was shadowed for access during their work day which made it possible to blend in and also made it easier to connect to the staff during the observations

and interviews (Myers and Newman 2007). A total of 14 days were used to shadow physicians, nurses and assistant nurses.

In-situ interviews were performed at the ICU and consisted of both informal unstructured interviews and more formal semi-structured interviews. Most of the informal unstructured interviews were conducted either during the observations or in the lunchroom during a break. The total time of these interviews is hard to estimate since they were not recorded. The informal unstructured interviews ranged from short inquiries to longer discussions and were vital for understanding the work context and analyzing the recorded interviews.

Since time at an ICU is precious and primarily reserved for patient focus, individual semi-structured recorded interviews with the observed staff were only conducted if time allowed. These individual interviews lasted between 10–55 minutes although many of them were restricted to a maximum of 20 minutes. Since the time for interviews was limited, the observations were important for creating a relationship with the staff and also made it possible to connect to events during the shift. A total of 18 recorded interviews were made (Table 3). Interviewing continued until the pre-implementation training started.

Table 3: Semi-structured recorded interviews

Role	Number of interviews	Total duration
Physician	4	1 h 50 min
Nurse	10	4 h 35 min
Assistant nurse	4	1 h 25 min
Total	18	7 h 50 min

One nurse was interviewed twice and the remaining respondents were interviewed once. There was an intentional emphasis on physicians and nurses relative to their numbers since the early interviews showed that they generally had more beliefs towards the PDMS than the assistant nurses had.

Interviews were performed in Swedish and all quotes have been translated to English by the first author. See appendix A for the interview guide that was used. Since time for the interviews was limited, all areas in the interview guide could not always be covered.

Analysis

An inductive approach was used in which the first author analyzed and coded the interviews (Thomas 2006). When coding the interviews, a total of 158 beliefs directed towards usefulness were identified in a first step, each consisting of one or several sentences. Initial categories were developed based on actual phrases in the text fragments. Each text fragment was then analyzed based on material from the observations and the unstructured interviews, consisting of approximately 40 pages of notes, together with the context within the interview. The analysis was performed iteratively and aimed at refining categories but also to questioning existing categories and searching for contradictory points. Whenever new categories were identified, all transcripts were reread according to the new structure, which resulted in five categories. Additionally, an overarching category of 'quality of care' was identified that included all identified categories. The iterative analysis was performed until theoretical saturation was achieved; that is, until further iterations did not change the emerging structure of categories. All five categories in the analysis emerged after analyzing the six first interviews, which suggest sufficient coverage and theoretical saturation. The analysis was based on how the respondents expressed usefulness and two of the categories contained, for instance, beliefs, which Davis (1989) defines as ease of use rather than usefulness, which will be discussed below. See appendix B for coding examples.

Exploring usefulness in a mandatory healthcare setting

The analysis revealed five categories and one core, overarching category. All categories captured how users attached meaning to the construct usefulness. The categories were: **User friendly**, which represents mainly how login, stability and latency will affect user experience. **Information quality**, which represents how information will be more detailed, accessible and less prone to misinterpretation due to poor handwriting, etc. Increased information quality is also expected to result in better clinical decision support. **Work practice**, which represents how the new system will change time allocation and prioritizations for some staff categories. **Spatial**, which represents how equipment required by the system will affect staff physically and spatially. **Transition**, which represents how work will be affected during the immediate time period after system implementation. The overarching category **Quality of care** captures how all beliefs towards usefulness are linked to how it will affect the quality of the care given to patients.

Figure 1 shows these identified categories. In the following sections, each of these are addressed in turn.

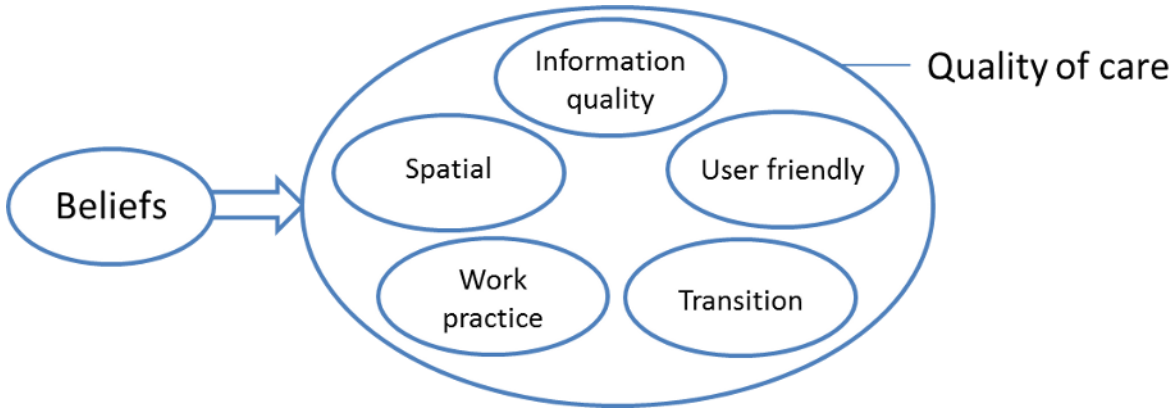

Figure 1: Direction of users' beliefs toward usefulness.

User friendly

Users expressed some but not many beliefs involving how user friendly aspects would affect how useful the system would be. Most beliefs were directed towards details such as how latency, login and stability would affect their work and therefore the patients:

> *I wish it's going to be quick, that it'll be responsive, so there are no long waiting times when you want to check something. As I understand it, it'll be bedside, and it's good to have things bedside but it shouldn't take too long to retrieve what you need.*
> - Physician 3

> *On paper I can put my signature and it takes no time but if you do it on your computer and, additionally, first have to log in with username and password while the system starts up, it will take a lot of time, stealing time and create a lot of frustration. So I hope it will be a simple login.*
> - Physician 4

When it comes to login but also stability and latency users stressed that it is important that the new system does not create more problems than it will solve and that the system will have solutions that fit their work processes, otherwise the system would not be perceived as useful since benefits for staff and patients cannot be utilized.

Information quality

Quality of information was the primary area within usefulness that all users had beliefs directed towards. The PDMS will automatically receive data from a lot of medical equipment and staff had a lot of beliefs concerning the integration and its consequences. They felt it could create a more detailed and accurate

documentation which is especially important in emergency situations when manual documentation is not prioritized.

> *Maybe you write once an hour but here you can see what happened every five minutes. It'll be a more detailed documentation.*
> - Assistant nurse 3

> *And then I think it can give a higher quality of documentation when things are documented as they are and not as now with a human filter. I can imagine it'll be more accurate.*
> - Physician 3

Respondents also talked about how manual documentation could lead to errors or ambiguities when information is hard to read. This concerned the vital parameters that would be sent automatically instead of manually documented but mostly beliefs concerning errors and unclarity were directed towards the manual medical documentations which would be clearer when digitized:

> *At the same time it will be clearer since sometimes you can't read what they've written, is it a one or is it a two?*
> - Nurse 8

To ensure that the current manual medication documentation is not misread, the medical prescription lists are carefully written by the nurses working the night shift so that the physicians in the morning can use the lists and cross out medication that is removed and only need to write the medication that is added.

Staff also expected that the quality of information would increase since information would be gathered in one place. Right now information is scattered over several documents. There are documents for vital parameters, wounds, medication, infections, infusions, laboratory tests etc and many of the documents have one copy for each day. Most patients have previously been in surgery and also have several documents from the surgical unit. When this information is gathered it will make it easier within the unit but also when patients are moved between units:

> *And you'll be able to follow fluid balance and infusions of various kinds from surgery to ICU so that it'll be one flow instead of two separate once as it is now.*
> - Nurse 6

This will also make it possible for more than one person to work with the information in parallel. For instance, the assistant nurse cannot document vital parameters while the nurse is doing the round with a physician since they are physically using the documentation.

Nurses and physicians expected that this would lead to more information to base their decisions on but also that they would be able to combine information in new ways that would facilitate decision making:

> *Physicians will have access to more information, which will make it easier to access necessary information for decisions.*
> - Physician 2

> *Patient safety will increase since it'll be gathered in one place. You can choose the parameters you are interested in […]. What kind of antibiotics do the patient have, how's the temperature and how're they related? Or the same with fluid balance. Or you can get statistics that would have required many hours of work today. We probably miss a lot today because we don't have the overview that we'll have with this system.*
> - Nurse 3

Physicians talked about information in general that would help them make better decisions while nurses talked mostly about fluid balance, which is considered vital at an ICU but is time consuming to calculate.

Work practice

Staff did not expect that the system would have a large impact on what they do but instead support their current work practice better. But there were some areas that they expected would change. Since the system will retrieve information automatically from bedside equipment there were beliefs that this might save time for the assistant nurses that manually document these parameters today:

> *If you've got patients with a lot of equipment then its lots of writing. You may not write every minute but you do hourly check-ups that take 10 minutes and much of that will be automatic.*
> - Assistant nurse 4

Since all medication will be prescribed through the system, some expected that it would be more time consuming for the physicians while the automation would make it easier for the assistant nurses:

> *In practice it will lead to extra work for physicians and a simplified work for assistant nurses.*
> - Nurse 3

Nurses also expected that the system would make them work more bedside since it would be natural to report using the bedside computer that will be delivered with the PDMS instead of going to another room:

> *I believe it'll change how we report [...]. With [the PDMS] we'll be bedside and go through all medications that are ongoing in [the PDMS] and compare it to the infusions and hopefully it'll be the same.*
> - Nurse 5

Nurses did not explicitly talk about what consequences this might have but instead mostly noted how work that previously had been done in another room, or by the common desks and computers, now would be performed at the bedside computer. Generally, though, when staff talked about bedside they indicated that time dedicated to the patient would increase, which increases quality of care.

Spatial

Most beliefs concerning usefulness were positive where staff expected that the new system will increase quality of care in different ways. However, there were also beliefs directed towards the spatial aspects of the system and all those beliefs were negative since the system would lead to more equipment that potentially could get in the way:

> *One thing that I'm concerned about is the space in the rooms if you're going to have even more screens. You have computers for [the EHR], the regular monitoring screens and now an additional screen for [the PDMS]. If a patient becomes circulatory unstable it might be difficult for us to access the patient from all directions.*
> - Nurse 2

It should also be noted that beliefs towards the spatial aspects were only present in interviews conducted more than six month before the implementation. At this time, wiring and installation of new monitors had been completed in most rooms. If the equipment was going to be in the way, it was now a reality. Staff was never asked specifically about the spatial aspects of the equipment but if they felt that it hindered them in their work the observations or interviews should have picked that up. A more probable reason is that staff realized that the equipment was not getting in the way or they found ways to work around it.

Transition

All categories of staff had expectations towards the transition — the point in time when the system was going live and the time after, until all had gotten used to the new system and work routines. None of these beliefs were positive and most of them negative. Staff expected that the transition would take both time and focus away from the patients:

> *In the beginning it will take time and focus away from the patients before we've learned to find everything.*
> - Assistant nurse 3

Since staff has used the current documentation system for several years, it will take time to adjust and update your routines to fit the new system especially in stressful situations. Within their current documentation system all personnel have developed strategies for when and how they detect anomalies and other situations that they need to act on. Since the system will change how they work they are worried that they will miss vital information when they have not had the time to update their personal routines to match the new work processes:

> *That you will forget the "clinical eye", that you won't look at the parameters as often as now. When you manually write it down you write it whether you like it or not and you have to really look and see.*
> - Nurse 7

Manually writing a value such as blood pressure or a laboratory test makes the staff reflect if that value is reasonable and maybe needs some kind of action. When laboratory tests and vital parameters are automatically sent to the system without the need of manual work staff needs to find new personal routines for when and how they look at information so they don't miss anything. Many staff members were worried and had negative beliefs towards how they would manage their work and not risk patient safety until they found new routines.

Discussion

Since the current study explores how users contextually attach meaning to usefulness, the scope is larger than that reflected by Davis' (1989) definition of usefulness. In many theories the categories 'user friendly' and 'transition' would be categorized as 'ease of use' instead of 'usefulness'. Theories that incorporate ease of use often suggest a causal relationship from ease of use to usefulness since ease of use affects how useful you perceive the system to be. It is therefore natural that elements of ease of use would be brought up by users when discussing usefulness. Ease of use is a natural part of TAM and UTAUT but is not always measured in IS continuance and ECT studies since its effects seem to become non-significant in later stages when users gain experience with the system (Davis et al. 1989; Karahanna et al. 1999). This is probably true when a system is unintuitive, which is a problem when you are not familiar with the system but less of an issue when you know the system or when usage is voluntary and you can choose not to use the system. But if logging in takes a long time or there is high latency, that would probably affect how useful a system is considered both shortly after the system has been implemented and when users have learned the system, especially if usage is mandatory. This might suggest that there may be ease of use aspects that influence satisfaction in later stages when system use is mandatory.

Many users had beliefs towards how work will be affected during the transition from paper documentation to the PDMS. This is interesting since the implementation was not included in the interview guide but was still brought up by most users. This is probably linked to the work context since patients sent to an ICU often linger on the verge of stability and staff consider patients' health and safety the priority, which is supported in findings by Ayatollahi et al. (2009). Users expect that the PDMS will change how they work and that they will have to get used to the system and create new personal routines while focusing on patients' health and safety. However, this is probably not a property of the system but rather related to change within the healthcare context.

Beliefs towards usefulness were explicitly and implicitly directed towards how the PDMS would increase quality of care by enhancing both the individual person's job performance and the performance of others, such as colleagues in different categories and the organization as whole. Some expected that the PDMS would save time for the assistant nurses, which is consistent with other studies (Wong et al. 2003; Bosman et al. 2003) and can be associated with an increase in productivity. Since time saving is relatively low, however, it would not allow them to care for more patients but maybe devote extra care to already assigned patients. Also, factors such as latency, stability and logging in could affect productivity depending on time gained or lost due to these factors. Some also expected that the system could lead to more work for physicians which could be interpreted as a decrease in their productivity. How medical professionals interpret Davis (1989) terms performance, productivity and effectiveness and how they are associated with factors such as quality of care and increased information quality is unfortunately unclear in previous research and in the interviews.

The literature shows that usefulness in healthcare has been measured with a variety of questionnaire items from different perspectives (Table 2). We have seen examples of items measuring usefulness both from the perspective of the individual and from a larger perspective including benefits for others, such as colleagues and the organization as whole. There are also examples of both non contextualized items that could be used in other organizational contexts and more contextualized items appropriate only within healthcare. The level of detail can also differ from more general items that can be used in all healthcare areas to more detailed including features of the specific system. Finally, there are items measuring beliefs

toward system features and the consequence of the features where almost all previous studies have used items measuring the consequences of the features in line with Davis' (1989) items.

The interviews revealed that medical staff had beliefs towards usefulness covering all perspectives found in previously used items except for items measuring explicitly voluntary aspects, such as using the system will increase chance of getting a raise. Some of the items found in the literature are more detailed which probably works well when the system is well known. Previous studies suggest that more general items are better for measuring pre implementation beliefs (Davis et al. 1989) since users may not have adequate prior experience or knowledge to form concrete beliefs (Khalifa and Liu 2002) or to relate to more specific questionnaire items (Bettman and Sujan 1987). The amount and depth of the beliefs captured by this study suggest that users in this unit have enough knowledge to relate to specific items but that is probably a result of them being a pilot unit and that several nurses had worked with a previous version of the PDMS in another hospital. Another problem with specific items is that physicians, nurses and assistant nurses expressed beliefs differently. They all had beliefs towards usefulness but these beliefs were influenced by how they will work with the PDMS. A more specific questionnaire item regarding decision making such as "Using the PDMS will increase decision support?" might be relevant for physicians and nurses but not assistant nurses. However, far from all countries have assistant nurses or equivalent which suggests that specific items adapted to only physicians and nurses are relevant in most healthcare contexts.

From the analysis of the empirical material two main areas was identified as relevant for questionnaire items regarding usefulness: information quality (including decision support) and quality of care. All users had beliefs towards information quality and questionnaire items explicitly directed at this is suggested by Mettler (2012) and Gagnon et al. (2014) and also by studies that more broadly investigate beliefs (Fitterer et al. 2011; Gans et al. 2005). Other studies (Schaik et al. 2002; Ortega and Román 2011) only implicitly relate to information quality when they inquire effects of the system since better information could lead to better diagnostics. Decision support is unfortunately an area not affecting all categories of staff in this context and only makes sense to include when addressing physicians and nurses. Items regarding decision support are not as common in the existing research but examples include how a system would enable the user to assess medical conditions (Shaik et al. 2002). Davis' (1989) item concerning effectiveness could also be interpreted as decision support as suggested by Ortega and Román (2011) but without explicit examples in the questionnaire item it is doubtful that medical staff in general would do that. Quality of care was identified as the overarching category involving almost all other categories. This is also the most frequent example of contextualization in the literature where it is referred to as patient care, quality of care and medical outcome (Aldosari 2003; Mettler 2012). Here we find both benefits when improving quality of care that the individual user delivers (Chismar and Wiley-Patton 2002) and improving quality of care in general (Gagnon et al. 2014).

Most studies use items that include only benefits for the single user while the interviews show several examples where benefits for others such as the patients are included. In a context with strong focus on patients and quality of care it might be valid to measure usefulness not only from the perspective of benefits for the single user.

Conclusion

More research is needed on how usefulness can be meaningfully measured within mandatory healthcare settings. The empirical results from this study suggest that it might be appropriate if items concerning usefulness (a) not only measures benefits for the individual person and (b) are contextualized, which would make it easier for staff to relate to the items. Previous research suggests that questionnaire items should be more general, so they can be used for measuring beliefs both pre and post implementation, since users does not always have enough knowledge to related to specific items before a system is implemented. Some examples based on the empirical results and the literature review are given in Table 4. These should be contrasted with the classic items from Davis (1989) to find out which are the most appropriate for measuring usefulness in mandatory healthcare settings. The suggested items consist of two main groups where the first three are general and contextualized versions of Davis' (1989) items that are directed towards benefits for the individual user while the last three are general, contextualized and include benefits beyond the individual user.

Table 4: Suggestion of questionnaire items for usefulness within healthcare
Using [system] would improve my performance (e.g. provide better care)
Using [system] would increase my productivity (e.g. more accomplished medical tasks)
Using [system] would enhance my effectiveness (e.g. better medical decisions)
Using [system] would increase information quality
Using [system] would increase quality in patient care
Using [system] would facilitate better patient care decisions

There is also a need to further investigate how medical staff interprets the terms performance, productivity and effectiveness when not contextualized or provided with examples. One could argue that medical staff might interpret the terms as providing better care, accomplishing more medical tasks and making better medical decisions. Therefore it is possible that Davis' (1989) classical items are appropriate measures of beliefs towards usefulness in mandatory healthcare settings even though users did not express usefulness in this way in the interviews.

This paper set out to explore how users' beliefs towards usefulness can be meaningfully measured in mandatory healthcare settings. Drawing on the literature and an in-depth qualitative study of a PDMS implementation at a large hospital in Sweden, we have shown that the classic questionnaire items suggested by Davis (1989) for measuring usefulness might not be the best in this context. Instead, it might be more appropriate to measure usefulness with contextualized questions that measure more than benefits for the single users. To achieve the required in-depth understanding of how the usefulness construct is appropriated in practice, a qualitative study of a single ICU was undertaken. Such an approach aims at analytical generalization rather than statistical generalization (Yin, 2013). Our hope is that our findings can prompt further research that explores how users attach value and meaning to different beliefs in different contexts. Such inquiry could use quantitative research to validate the suggested items and qualitative approaches to refine the items in other healthcare settings. Future research could also adopt the approach taken in this study to explore the appropriation of constructs and questionnaire items for other domains with their specific characteristics.

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Appendix A: Interview guide

Information
- When
- How much
- From who

Expectations
- Affect work
- Usability
- Learning the system

Experience
- With the system elsewhere
- Similar systems

Attitude
- Personal
- Categories/unit

Appendix B: Coding examples

Table 5: Coding examples

Transcript	Notes	Final category
You could look at trends and perhaps cause and effect in a simpler way. Sometimes it's not clear and it takes a lot of time to decipher what happened and how it relates to vital signs which correlate to medication and so on. That might be easier to see when everything is gathered.	When information is gathered it enables better decision support. Many talk about how the system will improve different aspects of information quality. Decision support seem to be closely tied to and a consequence of increased information quality and is therefore categorized as information quality instead of as its own category. It is also clear that this is a mean to improve diagnosis and medication which will improve quality of care.	Information quality, Quality of care
One can wish that it'll be quick, that it'll be responsive, so there aren't long waiting times […]. As I have understood it the system will be pretty patient centered which is good but it shouldn't take too long to find what you need.	Context: Long waiting times will cause frustration and steal time away from patients. It is connected to usefulness since a slow system will be seen as less useful but most part of ease to use are in that sense also connected to usefulness. If a system is slow it will steal time away from patients and the system will not be perceived useful which also might affect patients negatively.	User friendly, Quality of care