Communication Breakdowns between Nurses and IT Department: Why Hospitals Fail at Improving the Usability of Health Information Technology

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Often, Health Information Technology (HIT) in hospitals consists of off the shelf systems that are configured and implemented by IT department workers. This means that these employees have a significant impact of the usability of HIT systems. Nonetheless, we currently do not know how IT department workers work. This prevents us from formulating educated recommendations aimed at improving HIT usability, known to be poor, especially from nurses' perspective. In this paper, we hence present the results from an interview study, shedding light on 1) the communication channels that exist between nurses and IT department at a large public hospital in Sweden, and 2) the problems that undermine system-related communication between these two groups. Our findings stress the need for successful two-way communication between nurses and IT department in order to improve the usability of HIT in use.

Keywords
end user involvement, health information technology, IT department, nurses, user-centred design

1. Introduction

Health Information Technology (HIT) plays an important role in today's health care. The way information is handled, stored, and shared influences how effectively and efficiently care can be provided. By enabling clinicians to make better use of information, HIT has the potential to support them in taking the right decisions and actions, thereby improving patient outcomes. However, HIT is often plagued by usability issues [1, 2], which has been associated with negative outcomes for both patients and healthcare professionals [3]. Nurses, as the largest group of HIT users [4], have been particularly affected by the issues emerging from its use. Examples of reported problems related to HIT use by hospital nurses include additional work, stress, and errors [2, 5, 6].

Improving the usability of HIT systems will require efforts from both HIT vendors and healthcare organizations [3, 5]. Indeed, HIT systems used in hospitals often are off the shelf systems developed by HIT vendors and configured, implemented, and maintained by the health care organizations themselves [3, 5], and more specifically by employees from these organizations' dedicated Information Technology (IT) department. These employees, many of which have no formal background in computing, are key agents before, during and after the implementation of the main HIT systems used in hospitals, including the electronic health record (EHR). In consequence, it is indisputable that IT department workers play a significant role in the usability of HIT systems, through their influence on the systems' interface and functionality on the one hand, and through their role in shaping the systems' implementation and maintenance processes on the other [3, 5].

In spite of IT department workers' importance in the usability of HIT in use, we currently lack knowledge on how they work [3]. As a result, we currently are unable to formulate effective recommendations as to what healthcare organizations can (should) do to achieve higher HIT usability

[3]. A recent literature review on the topic has concluded that the "improvement [of HIT usability] will require that we more clearly identify where and when usability gets created or breaks down, [...] and how usability methods are used (and not used)" by IT department workers in healthcare organizations [3].

Following this call for more research, this paper investigates the perspective of IT department workers on system-related communication between nurses and IT department. Previous research indeed suggests that nurses' involvement in the design and evaluation of HIT is beneficial to its usability [4]. On the basis of two interview studies conducted with IT department workers at a large University Hospital in Sweden, we therefore address two main research questions:

- What communication channels currently support system-related communication between nurses and IT department?
- What breakdowns in these communication channels undermine (from IT department workers' perspective) system-related communication between nurses and IT department, thus negatively affecting the usability of HIT in use?

2. Related Research

2.1 Usability of Health Information Technology

Usability is defined in ISO 9241-210 as "the extent to which a system [...] can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" [7]. Usability is hence an assessment of 1) whether users can perform their work tasks with the system (e.g., marking a drug prescription as administered), 2) how quickly these work tasks can be carried out in the system (e.g., how long it takes to mark a drug prescription as administered), and 3) users' subjective assessment of how well a system fulfils their use needs.

The lacking usability of HIT has been widely acknowledged in the literature [1–3], including in the specific context of hospital nursing. In their recent examination of nurses' usability problems with HIT, Staggers et al. [6] found a wide range of issues, including mismatches between nurses' work practice and system design (e.g., single patient views while nurses care for groups of patients, individual work view while nurses work as part of an interdisciplinary team), fragmentation of patient information within and across systems, and lack of internal and external system interoperability. Additional problems include excessive documentation requirements (without compensation in other areas of nurses' work), as well as inadequate training and education [6]. Consequences of these usability issues for nurses include work inefficiencies, reductions in productivity, frustrations, increases in cognitive burden and stress, as well as threats to patient safety and gaps and errors in the care provided [6]. These findings coincide with other studies making a connection between poor HIT usability and multiple negative outcomes for patients as well as for clinicians [3].

It is therefore essential to improve HIT usability in order to ensure high quality of care and healthy working conditions for healthcare professionals. As made visible by the list of usability issues mentioned above, this requires work on the level of both HIT vendors (designers of HIT [3]) and healthcare organizations (implementers of HIT [3]), as both contribute to shaping HIT usability [3, 5, 6]. For instance, decisions about configuration, customization, and user training, all of which can have a significant impact on the usability of HIT in use, are made by healthcare organizations [3, 5], and more specifically by these organizations' IT department workers. As a consequence, for researchers, the "improvement [of HIT usability] will require that we more clearly identify where and when usability gets created or breaks down, [...] and how usability methods are used (and not used)" by IT department workers in healthcare organizations [3]. However, a major issue is that we still lack knowledge about how these implementers of HIT work [3], and thus cannot make effective recommendations as to what they should change and improve in their current work processes in order to achieve higher system usability.

2.2 End Users' Involvement in the Development Life Cycle and Usability

Usability is closely connected to user-centred design methods [8], which consist in taking into consideration the user and the physical, social and organizational context of use by involving end users in all phases of the system development life cycle [9, 10]. Ideally, a user-centred design process is iterative and has a continuous focus on the user [9], as user requirements affect all aspects of

system development [10]. Common methods used in user-centred design include personas, think aloud evaluations and workshop with users [11]. However, previous research has shown that user-centred principles are not systematically integrated and followed by HIT vendors [3, 8], even though there have been attempts at achieving such an integration [12]. There are for instance efforts in adapting user-centred design methods to public organizations in general [13], as well as more specifically to health care organizations, where these efforts have for example resulted in use scenarios [14] and multidisciplinary thematic seminars [15]. Nonetheless, the most popular user-centred methods used when developing systems (independent of the work domain) remain usability tests, interviews and questionnaire surveys [11]. In addition, the problem is that when user-centred methods are resorted to, they are often used too late in the design process [8], which limits the benefits they can provide.

Nowadays, agile system development is the prevalent model in both development and maintenance of IT systems at large [16]. Resorting to agile methodology has an impact on the degree of end user involvement in the development process. For instance, previous research has pointed to the fact that, in agile system development processes, feedback is often informal, and that lack of time leads to the (even more) limited use of user-centred design methods [17, 18]. Some researchers are therefore working on integrating user-centred design methods in agile development [16, 19, 20], while others work towards a new software development methodology that includes more time for user involvement, e.g. [21].

It is important to point out that the vast majority of the research looking into the involvement of end users (including nurses) in HIT development (e.g. the works we have referenced above) focuses on HIT vendors, and not on HIT implementers, i.e., IT department workers in hospitals [3]. There is very little research on user-centred design methods and user involvement in internal design, implementation and maintenance processes within healthcare organizations.

2.3 Nurses' Involvement in the Development Life Cycle of Health Information Technology

Nurses are the largest group of healthcare professionals [4] and the primary providers of patient care in hospital settings [22]. They are thus required to interact daily with HIT to 'track, organize, and update patient information' [22], and as such a key user group of HIT, whose ability to deliver high quality care can be hindered by poor HIT usability [6].

HIT usability issues in nursing can be associated with nurses' lack of involvement in this process, as "corporate decisions about health IT purchases are often made without adequate nursing input" [6]. However, research suggests that this lack of involvement of nurses throughout the design process of HIT is not solely due to HIT vendors' and/or implementers' disregard for nurses' needs. Nurses also seem reluctant to take an active role in the design, implementation and evaluation of HIT. Procter et al. [23] stress that "nurses at all levels have a choice, to continue to shy away from involvement in the development, implementation and evaluation of [HIT] systems, or take a leadership role and add [system-related] wisdom to their professional knowledge".

In conclusion, existing research on the (lacking) usability of HIT suggests that, if higher HIT usability is to be achieved, adequate input from nurses should be collected throughout the whole system development lifecycle, "from selection to tailoring/customization to implementation, evaluation, and optimization" [6].

3. Method

This paper reports on the results of an interview study carried out at the IT department of a university hospital in Sweden. Altogether 15 IT department workers were asked about their perspective on nurses' involvement in the design and implementation of HIT systems in their organization, as well as their perspective on the usability of these systems. Informed consent was obtained from the interviewees before each interview.

Participants were all involved in the configuration, customization and/or maintenance of the big HIT systems in use at the hospital, including an electronic health record, an operation planning system, and a patient vitals monitoring system. The participants' roles varied and their distribution across roles is presented in Table 1. The job titles given in the table are those used by the interviewees themselves.

The audio recordings of the interviews were transcribed verbatim, and the data were compiled and grouped into themes. We then extracted the findings related to these common themes and brought them into a coherent structure. The interview study has previously resulted in one bachelor thesis [24] and one master thesis [25].

Table 1 Participants' distribution across roles.

Role	Number of Participants
Care coordinator	1
Project leader/manager	5
Support staff member	4
IT technician	1
Application manager	4
Total	**15**

4. Results

Our participants, IT department workers at a large public hospital in Sweden, stressed the need for successful, two-way communication between nurses and IT department in order to achieve high HIT usability. This means that they saw both 1) getting information and feedback from nurses (i.e., nurses communicating their system-related needs and issues to the IT department) and 2) getting system-related information through to nurses (i.e., nurses assimilating system-related information from the IT department) as essential components of HIT usability. In other words, the IT department workers we talked to felt it was not enough for them to listen to nurses and take their needs into consideration in order to achieve high usability; nurses also needed to listen to (and learn from) them.

In accordance with this perspective on HIT usability, our findings address two main themes - always from the perspective of IT department workers at a large public hospital in Sweden:

- Communication channels between nurses and IT department;
- Breakdowns in these communication channels (i.e. in the communication between nurses and IT department).

4.1 Communication channels between nurses and IT department

Our participants mentioned several communication channels (or modes/means of communication) between IT department and nurses. These communication channels are presented in table 2, taking into consideration the direction of the communication for each channel (i.e., whether from nurses to the IT department or from the IT department to nurses or, in cases of two-way communication channels, both). In the remainder of this section, we describe each communication channel in some more detail.

Table 2 Communication channels between nurses and IT department.

Direction	Communication Channels
Nurses → IT dept.	Electronic error reporting system
	Meetings between IT department and nurse representatives
Two-way communication	Instructor-led training workshops
IT dept. → Nurses	Nurse managers
	Intranet

Electronic Error Reporting System

When, or after, encountering a problem during an interaction with a system, nurses can report (i.e., describe) the issue in a structured way via an electronic reporting system.

The system error reports thus created in the system by nurses are then scanned by a care coordinator, who performs an evaluation of the relative significance of each reported issue, assigning different priority rankings to different error reports.

Finally, the high-priority error reports are forwarded to the IT department. IT department workers can then on this basis identify the HIT-related aspects nurses struggle with as well as the system components in need of improvement.

Meetings between IT department and nurse representatives

One of the application managers we talked to indicated meeting with nurse representatives four to six times a year to discuss system-related issues. More specifically, the interviewee mentioned asking nurses about their "thoughts and needs" regarding the continuous development (improvement) of systems already in use. However, no details were provided as to the composition, form and goals of these sessions.

Instructor-led training workshops

Instructor-led training sessions are provided to different user groups when (often shortly before) new systems managed by the IT department are implemented or going through a significant update (e.g., when new features are being implemented). These workshops are primarily aimed at teaching the system's end users how to interact with the system and/or its new features, i.e., supporting communication from the IT department to the nurses (and other medical staff). Nonetheless, interviewees also described them as good opportunities to gather staff's (including nurses') opinions on system functionality, i.e., supporting communication from the nurses to the IT department, allowing IT department workers to identify changes to be made even before the full implementation of the new system or features. In consequence, instructor-led workshops appear to be the only two-way communication channel between nurses and IT department (in the investigated research setting).

Nurse managers

Participants stressed nurse managers' function as intermediaries between IT department and nurses. According to our participants, nurse managers are one of two channels through which IT department workers in our research setting can communicate system-related information to nurses (the second one being the intranet, see below). Nurse managers have daily, face-to-face meetings with their staff and, according to our participants, using these meetings to rely messages from the IT department is part of nurse managers' duties. In that sense, nurse managers are, from nurses' perspective, a "push" medium, i.e., a way for nurses to get system-related information without actively looking for it.

Intranet

The intranet is the second channel through which the IT department can communicate system-related information to nurses. In contrast to the first channel (i.e., nurse managers, see above), the intranet is a "pull" medium, meaning that nurses actively need to go and fetch the information in order to receive it.

4.2 Communication breakdowns between IT department and nurses

Our participants mentioned breakdowns (problems) in several of the communication channels between the IT department and nurses. The mentioned breakdowns affected both the communication from nurses to the IT department (i.e., nurses' feedback on system-related issues) and the communication from the IT department to the nurses (i.e., information about the systems and their use).

With the exception of the higher-level issue of lack of time, channel-specific problems were mentioned in relation to three of the identified communication channels:

- *Low quality and low-level filtering of reports* in relation to the electronic error reporting system;
- *Non-attendance of nurses* in relation to the instructor-led training workshops;
- *Misalignment between nurse managers' and IT department workers' priorities* in relation to nurse managers (and, indirectly, instructor-led training workshops and the intranet).

In the remainder of this section, we take a closer look at what our participants said about each one of these issues they identified as hindering the communication between nurses and IT department.

Lack of time

Lack of time was mentioned by our participants as an obstacle to effective communication between IT department workers and nurses in multiple ways, affecting both the IT department's and nurses' ability to receive system-related information from each other.

For IT department workers, lack of time is a factor hindering them from carrying out continuous user surveying over the long term. This is something our participants expressed some frustration about, as they indicated that having the time resources to investigate end users', and more particularly nurses', needs more in depth would help them to better understand their needs as well as diagnose and solve system-related issues more effectively.

For nurses, lack of time was mentioned by our interviewees as one of the reasons why they did not attend the instructor-led training workshops provided by the IT department as well as why they did not access the hospital's intranet to read system-related information placed there by the IT department.

Low quality and low-level filtering of electronic error reports

Several of the IT department workers we talked to felt that nurses lacked the technical knowledge required in order to describe system-related breakdowns in an appropriate way when filling in an electronic error report. In their experience, the low quality of the problem descriptions provided in the reports submitted by nurses did not allow them to understand what had gone wrong in the interaction between the end user and the system, what had caused the issue, and how it could be fixed. Participants attributed this issue to nurses' lack of IT skills, and connected this lack of IT skills to nurses' non-attendance to the instructor-led workshops proposed by the IT department (see below). It is also worth adding that participants felt that nurses' lack of system know-how resulted in a significant amount of, from their perspective, unnecessary error reports - reports of problems not caused by technical issues or bugs in the systems, but by the users' ignorance as to how to carry out a task "properly" in the system.

Beside the (assessed) low quality of the error reports, another problem participants saw in electronic error reporting in its current form in their organization was the low-level filtering of reports carried out by care co-ordinators. As described in the previous section, electronic error reports filled out by nurses (and other end users) are first sorted by a care coordinator, and only the issues ranked as high priority (by that co-ordinator) are forwarded to the IT department. Therefore, not all system-related issues reported by nurses reach the IT department. For some interviewees, this created a risk for potentially significant issues to remain unnoticed by the IT department and thus being left unresolved. Participants described the lack of shared priority-setting guidelines between care coordinators and IT department workers as being at the core of this problem.

In short, not only are electronic error reports badly formulated (making it hard for the IT department workers to understand what the problems are), not all of them reach the IT department.

Nurses' non-attendance to the instructor-led training workshops

The IT department workers we talked to mentioned nurses' non-attendance to the instructor-led training workshops provided by the IT department as a significant issue, with multiple causes and consequences.

In regard to causes of nurses' non-attendance to the training workshops, our participants mentioned two main factors: 1) the limited capacity of the workshops (i.e., not all nurses in the interviewees' organization could take part in these instructor-led training sessions), and 2) nurse managers' lack of cooperation (i.e., not sending their staff to training). Indeed, nurses are dependent on their manager(s) to be given time to attend an instructor-led training workshop; in other words, their attendance needs to be added to their schedule by their manager(s). If nurse managers do not take that step, nurses are left unable to attend the training sessions (even if free spots are available). Our participants experienced a lack of cooperation from nurse managers in this regard, finding that nurse managers were not giving nurses' system training the importance it deserved (see below).

As these instructor-led training workshops were described as the only opportunity for two-way communication between IT department and nurses, nurses' non-attendance was considered a particularly serious issue by our participants. In their view, it results into 1) nurses learning how to use systems by imitating their colleagues, which means "mistakes" in the interaction with systems are passed along, leading nurses to experience low usability and, potentially, to generate technical issues

through "wrong" manipulations, and 2) nurses not discussing their needs with the IT department workers.

Misalignment between nurse managers' and IT department workers' priorities

As mentioned above, the IT department workers we talked to felt that nurse managers were not giving nurses' system training the importance it deserved. As a result, they are not scheduling instructor-led training workshops for their nurses and not (always) communicating all the system-related information they receive from the IT department to their staff, or are not doing it quickly enough (in our participants' view).

Our interviewees connected this issue - the lack of importance given by nurse managers to system-related information and training provided by the IT department - to the current shortage of nurses in their organization as well as to the time-intensive nature of nursing work (e.g., long working hours). In the specific case of system-related information from the IT department, which nurse managers are, according to our participants, expected to communicate to their staff, another reason for nurse managers' perceived lack of cooperation was the availability of that information on the organization's intranet. In other words, our interviewees' statements suggest that nurse managers expect nurses to actively go and seek out system-related information from the IT department, and thus refuse to take responsibility for "pushing" that information onto their staff. However, as already mentioned, nurses often seem to not have (or take) the time to go and check the system-related information the IT department places on their intranet.

5. Discussion and Conclusion

This paper contributes to existing research by investigating the different ways in which IT department workers and nurses communicate with each other about HIT-related issues, both before implementation (e.g. about nurses' needs), during implementation (e.g. system training and configuration), and after implementation (e.g. system errors). It thus sheds light on an important part of IT department workers' practices, something that has been identified as a research gap [3].

More specifically, this study identifies five different communication channels supporting communication either from nurses to IT department, from IT department to nurses, or both (two-way communication). Electronic error reports and meetings between IT department and nurse representatives are the two channels found to enable nurses to communicate their system-related needs and problems to the IT department. In other words, these two communication channels support nurses' involvement in the design, implementation and improvement of HIT systems. Previous research, e.g., [8, 10], has stressed the importance of end users' involvement throughout the system development life cycle in achieving high system usability. Instructor-led training workshops was found to be the only communication channel supporting two-way communication between nurses and IT department, allowing IT department workers to teach nurses how the systems work and allowing nurses to tell IT department workers about their system-related needs and problems. Finally, nurse managers and intranet were found to be the two communication channels supporting the transfer of system-related information from the IT department to nurses. The need for nurses (or end users in general) to receive system-related information from the implementers of HIT in order to experience higher system usability is a key finding of this paper, as the importance of successful two-way communication between IT department and nurses (as opposed to "just" considering nurses' needs in the system development life cycle) in "creating" usability has not been stressed in the existing literature in the topic.

Our study also identifies four main breakdowns negatively affecting communication between IT department and nurses. Beside the more general issue of lack of time, these breakdowns were (directly or indirectly) connected to specific communication channels. For instance, low quality and low-level filtering of error reports were found to hinder effective action-taking based on electronic error reports submitted by nurses to the IT department; nurses' non-attendance was found to reduce the potential positive impact of instructor-led training workshops on nurses' system-related know-how, as well as on IT department workers' awareness of nurses' system-related needs; and misalignment between nurse managers' and IT department workers' priorities was found to hinder the communication of system-related information from IT department to nurses through nurse managers, as well as to contribute to nurses' non-attendance to training workshops.

If we now take a closer look at the communication channels supporting nurses' communication of their system-related needs and problems to the IT department (i.e. electronic error reports, meetings between IT department and nurse representatives and instructor-led training workshops), we see that

our findings concur with previous research pointing to the insufficient involvement of nurses into HIT design [18]. Indeed, it is obvious that nurses are not continuously involved in the system development life cycle, and that the identified communication breakdowns in these nurses-to-IT-department channels (i.e. low quality and low-level filtering of electronic error reports and nurses' non-attendance to training workshops) undermine nurses' already limited involvement in system design, implementation and improvement.

As user involvement in all phases of the system design life cycle is associated with greater usability [3, 9, 10], it is urgent for healthcare organizations to fix these breakdowns. When it comes to the low-level filtering of electronic error reports, our study stresses the need for care coordinators and IT department workers to have a common set of guidelines on how to prioritize reported system-related issues to reduce the risk of significant issues not being transferred to the IT department. An alternative solution could be to have all error reports transferred directly to the IT department, without the involvement of a third party. When it comes to the low quality of electronic error reports, our results suggest that instructor-led training workshops need to be 1) extended to all nurses in the organization, and 2) aim not only at allowing nurses to interact with the systems, but also at enabling them to describe the issues they encounter in terms IT department workers can understand. Indeed, others have shown that the competence needed to participate in software development (or improvement) does not come naturally to nurses [14]. Ultimately, this is also about integrating computer literacy in nursing education [26]. In addition, our findings point to the need to provide nurses with the time to report system-related errors and to attend instructor-led training workshops. Our findings suggest that nurse managers have the ability to make a difference here, and that they need to assign a higher priority to nurses' exchanges with the IT department.

Lack of time was however found to not only be a problem for nurses (preventing them from giving and receiving system-related information), but also for IT department workers. In particular, IT department workers need to be given the time to collect end user feedback continuously and over the long term. Time restrictions limiting the ability to collect information about end users' system-related needs and problems is a problem that HIT vendors also experience [17]. This problem is closely connected to agile software development processes being dominant, as speed and agility are core values in the agile development model. We hence need to work more with the integration of user centred design methods in agile development [16, 19, 20], or work towards a software development methodology where there is more time for user involvement, such as for example [21], and which can be used in health care.

Interestingly, participants did not note any breakdown in relation to meetings between IT department and nurse representatives. However, it is also unclear exactly what impact these meetings have on the configuration, customization and improvement of HIT systems. More research is needed in order to identify the exact benefits and breakdowns connected to this way for IT department workers to collect information about nurses' system-related needs and problems.

5.1 Limitations

This paper reports on the perspective of IT department workers from one single IT department of a large hospital in one Swedish county. Our findings are therefore not generalizable, but we believe that readers doing research in a similar setting (i.e., large hospital using off the shelf systems managed by a dedicated IT department simultaneously acting as the third line of support) may find these findings transferrable to their particular setting. More research with a similar focus but in different settings is needed in order to understand IT departments' work with nurses' involvement into HIT design more fully. In addition, we want to point out that this study solely reflects IT department workers' perspective on communication between IT department and nurses. Studies examining the perspectives of other roles part of the communication channel(s) between nurses and IT department, such as nurse managers and nurses, are needed in order to gain a more complete understanding of the phenomenon.

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