Healthcare of the Future 2022
T. Bürkle et al. (Eds.)

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doi:10.3233/SHTI220321

Digi-Care: Exploring the Impacts of Digitization on Nursing Work in Switzerland

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Abstract. In this paper we present first findings of the Digi-Care project, a multidisciplinary, multi-stakeholder research project investigating the impacts of digitization on nursing work practices and in particular the transmission of patient care information within and beyond nursing work practices. We completed the initial data collection of the funded 3-year research project and report on a plethora of significant and critical IT-related events. Some of them can be attributed to usability issues.

Keywords. Information Exchange in care settings, IT usability, evaluation, EPR systems

1. Introduction

Poor alignment between IT systems, workflows and actual work practices in clinical environments has been shown to have adverse effects upon patient care [1]. Poor software usability has been described as a contributing factor to such problems (e.g. [2]). Traditionally, usability is assessed using formative methods such as think aloud [3] and cognitive walkthroughs [4] in laboratory environments. Heuristic evaluation [6] and user-centered approaches including questionnaires such as SUS [7] have been successfully used for summative evaluation approaches.

These traditional approaches tend to underestimate the number of software issues, and it is difficult to assess the impact upon experienced versus inexperienced software users. Thus, Kushniruk et al. have advocated layered approaches of system testing with clinical simulations and naturalistic studies in real-world environments for level 3 evaluation to determine the organizational impact of IT systems [8,9]. Such studies in real-world environments do not only reveal pure usability problems, but a broad range of potential errors as described by [10]. In this paper, we report preliminary results of such a study performed in six Swiss hospitals with the intention to

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1. identify and characterize situations in which the transmission of patient care information (PCI) with digital devices is perceived as significant or even critical, and derive required nursing competencies to deal with such situations
2. use selected situations as bases for stimulating learning and development related to the sharing of clinical information

2. Methods

Digi-Care has a cooperative study design which comprises several project stages in a three-year time frame.

The first stage (ethnographical study and data collection) consists of semi-structured context interviews with nurses and IT responsible persons and an extensive workplace observation to collect data about nursing work practices and the transmission of PCI in six Swiss hospitals sized between 200 and 400 beds. We conducted observations in orthopedic units, gynecology, urology, interdisciplinary and also surgical departments. Four observers (KL, S-MM, SP, AV) observed four different nurses in each hospital. The nurses participated voluntarily, they hold a tertiary-level degree, they are responsible for direct patient care and work at least 80%.

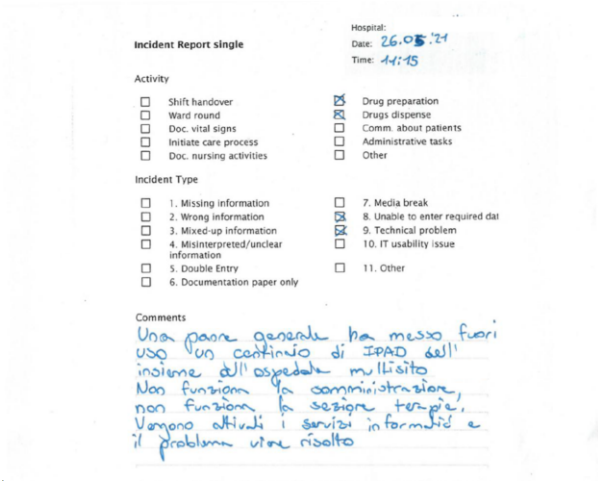
After a six-day familiarization in the respective hospital and ward, the observer followed a registered nurse for three consecutive work shifts and recorded crucial moments of the use of digital tools as well as non-digital tools and forms of transmission of PCI on video. A GoPro Hero 8 Black camera with extra power supply was carried in a chest harness to capture the entire situation. In addition, each observer carried a Nokia 8.1 smartphone featuring dual rear cameras for occasional close-up shots, e.g. data displayed on computer screen. To ensure high quality sound recording the observed nurses were equipped with RØDE Wireless GO microphone transmitters and the corresponding receiver was connected via USB-cable for sound input to the GoPro camera of observer. Subsequently, the video footage of these three shifts was cut into a one-hour video with Adobe Premiere Pro. This video was discussed with the observed nurse in a so-called self-confrontation interview, aimed to identify the PCI situations and the situated components of nurse's experience.

To identify IT-related incidents, we derived a paper-and-pencil template for the observer to identify exactly when and at what location the incident happened, and to characterize it in relation to the performed activity (e.g. shift, handover, drug preparation, etc.) and in relation to an incident type (e.g. missing information, double entry, media break, etc.). An exemplary incident report is given in Figure 1. Additional video footage was recorded for IT-related incidents. The incidents were coded (e.g. D3 for the third observed incident in the hospital D) and collected in an Excel spreadsheet with date, incident type, activity, short description, categorization and priority.

The second stage of the project will cover the selection and validation of interesting PCI situations and IT-related incidents in an iterative stepwise process. In the first step the researchers themselves will group and classify PCI situations and IT-related events. In the second step these findings will be discussed with participants in the observed hospitals. In the third step workshops with external experts will be held to further condense the data.

In a coming third stage both prototypical educational instruments for improved coping with selected situations and prototypical technical mockups/solutions to prevent selected IT-related events which concern bad IT usability will be developed. Further

project stages include the validation of these prototypes in workshops and the dissemination of the results.



Incident Report single

Hospital:
Date: 26.05.'21
Time: 11:15

Activity

- ☐ Shift handover
- ☐ Ward round
- ☐ Doc. vital signs
- ☐ Initiate care process
- ☐ Doc. nursing activities
- ☒ Drug preparation
- ☒ Drugs dispense
- ☐ Comm. about patients
- ☐ Administrative tasks
- ☐ Other

Incident Type

- ☐ 1. Missing information
- ☐ 2. Wrong information
- ☐ 3. Mixed-up information
- ☐ 4. Misinterpreted/unclear information
- ☐ 5. Double Entry
- ☐ 6. Documentation paper only
- ☐ 7. Media break
- ☒ 8. Unable to enter required dat
- ☒ 9. Technical problem
- ☐ 10. IT usability issue
- ☐ 11. Other

Comments

Una pausa generale ha messo fuori uso un centinaio di IPAD dell' insieme dell'ospedale multisito
Non funziona la somministrazione, non funziona la sezione terapie, Vengono attivati i servizi informatici e il problema viene risolto

Figure 1. Documentation template for critical IT incidents.

3. Preliminary Results – IT-related events in the first 5 hospitals

At the time of writing this paper, the 3-year project was still in its early stages, with 14 of 37 planned months completed. 320 hours of job shadowing time have been recorded until November 2021. 16 contextual interviews and 16 self-confrontation interviews have been completed.

IT-related events are assessed separately from the PCI situations which may or may not involve any digital tool, paper, phone or oral communication. To begin the second stage, the medical informatics researchers (TB, JH, FvK, CL and LM) started analyzing the first IT-related events. 144 such events have been recorded in five of the six hospitals, with data of the last hospital still under analysis. For future prototyping activities we will concentrate mainly on usability issues involved in the IT–related event.

Table 1 represents an example of such an event. It could have had considerable adverse effects for the patient. This event cannot be uniquely attributed to bad IT usability. Initially, the prescribing physician erroneously documented an incorrect amount of diluting liquid for the antibiotic. An inappropriate default list of available solutions for antibiotics could have contributed to this error, but other reasons such as work overload may be likely as well. If both 500mg and 1g dosage of Vancomycin are common in the hospital, an intelligent decision support rule would be required to assure in all cases, that the combination of antibiotic and dilution is always correct. Thus, the event was classified as technical and/or usability related, since additional decision support modules would be needed to catch such situations. In addition, this event was classified as highly critical. Typical for many such critical situations, the experienced nurse noticed that the administration of 1g Vancomycin with the prescribed dilution would be incorrect. She corrected the error herself and notified the physician so that no harm was done.

Table 1. Example of a recorded IT-related event.

Code	How often	Incident type	Activity	Text	Assessment
B3	Once	Mixed up information	Drugs dispense	Wrong prescription of Vancomycin: Vancomycin needs to be sufficiently diluted to be administered intravenously. The prescription was for Vancomycin 1g, but the indications for the dilution based on Vancomycin 500mg. The nurse was experienced enough to notice the wrong prescription and administered the IV antibiotic correctly and called the responsible person from the medical staff to adjust the prescription. The IT system does not have a built-in alert for this case of mixed-up or wrong prescription.	Usability / technical

Other recorded events included e.g. unexpected system downtime as well as duplicate documentation due to missing or insufficient IT interfaces between different department systems. Numerical results for the first five hospitals which have been analyzed are summarized in Table 2. The 144 events are distributed unevenly, resulting in between 1.25 to 3.92 events on average per shift.

Only 23 (16%) of the 144 observed IT-related events have been classified unanimously as pure usability problems. Many events had a mixed nature in terms of being classified as a) technical and usability, because they could be remedied e.g. by additional software modules, additional or better interfaces or they were considered b) mixed case vignette and usability, because education and training should or did help to overcome such situations.

Table 2. IT-related events in the first five hospitals.

	IT-events total	IT-events per shift	IT events per hour
Hospital A	24	2.00	0.25
Hospital B	36	3.00	0.38
Hospital C	15	1.25	0.16
Hospital D	22	1.83	0.23
Hospital E	47	3.92	0.49
Average	28.8	2.40	0.30

Some of the recorded IT-related events will need discussion in subsequent project stages not only with involved staff but also with external specialists, e.g. psychologists or specialists in learning, helping us to understand how and why human memorize relevant information. We noticed, for example, that in four out of five hospitals, nurses use a paper-based sheet (either printed from the EPR system or completely handwritten) to record the essential facts of the patients they care for in the respective shift. Part of this documentation was later copied back into the EPR. This process or habit leads to a higher degree of duplicate paper-based documentation and media breaks. On the other hand, handwritten notes may help the nurses to memorize important facts and synthesize the main information concerning the patients for their care activity [11].

4. Discussion

Our approach differs from that exemplified in [8] since we did not perform a full think-aloud study with screen recording of user actions. Instead, we performed an unobtrusive job shadowing study in real-world environments and asked our observers to take additional notes of observed IT-related events. Furthermore, we asked them to do a close-up recording of the computer screen with the smartphone camera if possible. Thus, in accordance with [12], we cannot be sure that we have captured all IT-related incidents in the observed time period and we are prone to some inter-observer bias.

On the other hand, we performed a multi-centric study, involving several different EPR systems in the observed hospitals. This broad approach of a field study should deliver interesting insights not only in terms of IT-related problems but also regarding how experienced staff members cope with such problems. We encountered, e.g. system breakdown times in one site and recorded how nurses dealt with this situation. As mentioned, other parts of the study design [13] will supply a systematic review of PCI situations and the way nurses deal with them using the methods of self-confrontation interviews and semiological analyses [14,15]. That part of stage 2 is still ongoing.

Initially, we expected significantly fewer IT-related events, e.g. one to three events in all three shifts of one ward, and were thus overwhelmed seeing four and more IT-related events in a single shift. This seems to be an indicator that digitization of documentation in inpatient care is not yet in a desired stage. As mentioned above, the observed events are not purely usability problems of a software product in use, but often a combination of missing interoperability, media breaks and duplicate documentation, which could be remedied by building better interfaces between different IT applications as part of the respective EPR system. Such effects were observed e.g. when patients went to the theatre for surgical interventions and documentation was therefore split among different IT-systems in anesthesia or the ICU.

In our observation, several potentially critical IT-related events have been prevented by alert staff noticing and correcting the error. This was the case, for example, when nurses noted, that physicians had entered a drug order in the EPR for the wrong time (before instead of after surgery). Here, different reactions could be observed. In some cases, nurses corrected the problem themselves and notified the physician, in other cases they were unsure and had difficulties to reach the ordering physician. Thus they undertook extra efforts to clarify the situation. This will be a topic for further examination and discussion in future stages of our study.

The level of digitization in the observed hospitals varies, but there is currently no clear indicator that a higher degree of digitization corresponds to less IT-related events. We plan to classify the observed level of digitization at the respective hospital to enable further investigation of this issue.

Summarizing, we observed many of the situations described in [10], such as fragmentation of data, problems with transfers, workarounds, or “misinterpretation of communication as information transfer”, often combined with loss of feedback. The latter two are the basis for our further work and should provide opportunities for discussion and development of better IT solutions. Usability is too important to be left to managers and software designers. For actual change we need to bring a sense of good usability to the people who benefit the most which are in this case the nursing staff [15].

5. Outlook

The essential steps of stage 1 comprising data collection and job shadowing in all hospitals were completed by the end of 2021. Stage 2 analysis of the IT-related events has started and analysis of the PCI-related situations is underway in parallel.

For further consideration of the IT-related incidents, we distributed the spreadsheet with all incidents among the medical informatics researchers (TB, JH, FvK, CL and LM) to prioritize those issues to be investigated further. In three workshops, the findings were discussed and a condensed list of 26 incidents for the first five hospitals emerged.

The next steps of stage 2 include the feedback process hospital staff and other professionals working in the field to create a shortlist of those PCI situations and IT-related events which are considered particularly relevant to most sites. For these IT events we will in stage 3 develop prototypical alternative IT designs and/or workflows to demonstrate how improved usability could help avoid the observed problem. These designs will be validated in a subsequent feedback loop in stage 4.

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