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Clinical Simulation and Workflow by Use of Two Clinical Information Systems, the Electronic Health Record and Digital Dictation

Sven Koldby[a], Iben Schou Jensen[b]

[a] *Unit for Projects and Implementation; IT, Medical Technology and Telephony Services; The Capital Region of Denmark*
[b] *Unit for Customers and Business; IT, Medical Technology and Telephony Services, The Capital Region of Denmark*

Abstract

Clinical information systems do not always support clinician workflows. An increasing number of unintended clinical incidents might be related to implementation of clinical information systems and to a new registration praxis of unintended clinical incidents. Evidence of performing clinical simulations before implementation of new clinical information systems provides the basis for use of this method. The intention has been to evaluate patient safety issues, functionality, workflow, and usefulness of a new solution before implementation in the hospitals. Use of a solution which integrates digital dictation and the EHR (electronic health record) were simulated in realistic and controlled clinical environments. Useful information dealing with workflow and patient safety were obtained. The clinical simulation demonstrated that the EHR locks during use of the integration of digital dictation, thus making it impossible to use the EHR or connected applications during digital dictation. The results of the simulations showed that the tested and evaluated solution does not support the clinical workflow. Conducting the simulations enabled us to improve the solution before implementation, but further development is necessary before implementation of the solution.

Keywords:

Patient Safety; Clinical Simulation; Workflow; Clinical Information Systems; Electronic Health Records; Digital Dictation.

Introduction

Implementation of clinical information systems (CIS) does not always support workflow across the involved applications. By using simulation in realistic clinical surroundings, it is possible to demonstrate benefit and implications of the connections across and between different CIS-applications and the workflow for the clinicians. The 'IT Experimentarium' (ITX) provides a set up to evaluate the context of CIS, organization, and workflow without interfering with real patients in the ward [1].

Dictation has been used for decades to transform spoken notes to written entries in the electronic health record (EHR). Dictation by tapes has also been used for years with well-known challenges like poor sound quality and lost tapes. There is no visible identification of the patient on the tape, only spoken identification. The records on the tapes are not saved after transcription because the tapes are re-used. Although each tape is used for one patient at any given time, re-use of the same tape to another patient might result in parts of the former record persisting on the tape. These particular problems are solved with implementation of digital dictation as a stand-alone application without an interface to the EHR. Use of both applications requires a login to each of the applications. Most hospitals in the Capital Region of Denmark have used digital dictation since 2008-09[1].

To ensure the correct and unique connection between the dictate (audio file) and the correct EHR, the patient's unique identity number is used in both applications. A typical mistake is a wrong relation between the patient's unique identity number, and the patient. On the one hand, patient safety might be improved, because the dictate is now available from a server, in contrast to analogue dictations. Because the audio files are saved in a central server, it is possible to trace such errors. On the other hand, patient safety has been compromised, because some record entries (dictations) were written in another patient's record (from the same ward), rather than the record of the intended patient. The increasing numbers of reported unintended clinical consequences might be related to this matter.

Unintended clinical consequences include incidents, close to failures or failures in the treatment of patients. In 2004 a national reporting system was introduced in Denmark [2], and since 2010 hospitals are obliged to register the occurrence of unintended clinical consequences [3]. By routine registration, an increasing number of incidents are registered. One of the reasons to the increased numbers is the new registration-praxis. Another major reason might be conditional to implementation of a new CIS, with changed organization and new workflows for the clinicians [4]. The attention to incidents related to use of the CIS has increased focus on the potential for new clinical incidents.

It has been documented that poor integration with other CIS leads to unwanted time-consuming tasks, e.g. a new log-in to another system [5]. Regarding the use of dictation and the EHR, some data has to be entered manually into both systems.

With implementation of integration between digital dictation and the EHR, we expect a reduction of unintended clinical consequences. Use of the solution links the specific record to the correct patient in the correct ward. Although we expect improved patient safety, we might also register some new unintended clinical consequences by introducing a new solution. For instance, dictations might be placed on a department other than where the patient is registered. By simulation in controlled environments (with actors as patients), the workflow, using the new integration can be demonstrated.

The purpose of the clinical simulation is to evaluate the workflow and functionality in the present solution with integration

[1] Three somatic hospitals (of 14) were not included in 2009.

between digital dictation and EHR, and to uncover any necessary needs for further development of the integration. The targets for the simulation were testing of dictation, listening, and transcription of dictations (clinical files):

- Does the solution with integration support the clinical workflow?
- Is the functionality in the solution sufficient?
- Do the users obtain improved effectiveness or better quality, e.g. improved patient safety?
- Use of the integration as input to education materials provided for future implementation of this solution.

During clinical simulation we are able to demonstrate and evaluate whether the new functionality meets the clinicians' expectations, and whether it honors functional demands/requirements of the CIS.

Experiences from implementation of other CIS in the Capital Region of Denmark, have illustrated divergence between clinical needs and the available solution. Articles substantiate this acknowledgement [6]. This emphasizes the necessity of clinical simulations before implementation of new CIS.

Furthermore, our organization has decided, that all new clinical applications in the Capital Region of Denmark must be evaluated by clinical simulation before implementation.

Materials and Methods

Clinical simulation

During the last decade simulation has been increasingly used as a phase in design and evaluation of CIS [7-9]. The impact of CIS on clinician workflow can be demonstrated by performing clinical simulations prior to implementation of CIS [4,10]. By performing clinical simulations, it is possible to reflect the daily use of the CIS, and to what degree the solution description is present in the application.
The use of clinical simulations in controlled environments eliminates the risk of injuring patients in real life, thereby avoiding unintended clinical consequences [11].

Location and artifacts

Since 2007, the Capital Region of Denmark has performed clinical simulations at Herlev Hospital in Copenhagen, where the Danish Institute of Medical Simulation (DIMS) is located. DIMS incorporates a full-scale hospital ward with 16 patient rooms, an operating theatre, and a fully equipped medicine room. One of the purposes of DIMS is to increase patient safety by performing medical simulations [12].
The facilities are designed for clinical training and testing, and the 'IT Experimentarium' uses these surroundings to perform simulations as part of the design and evaluation of clinical information systems and workflows [13].
Regarding many simulations at ITX, several preparations are conducted [14]. The new application is installed and tested on the laptops and network at ITX. Prior to the simulation, detailed scenarios are planned, containing purposes and instructions for each role. To perform the simulations, we invite relevant clinicians to participate. Accurate preparations are crucial to prevent unnecessary waste of valuable time for the clinicians, and a rehearsal with the technical setup is therefore performed in advance to the simulations.

Roles

To conduct the simulations, the ITX setup includes these roles supplemented with a specialist in Patient Safety:

- Test director – placed in the control room
- Test coordinator – in the simulation/ward room (with intercom to test director)
- Test participants "clinicians" – in the ward room
- Observers – in the ward room and the observation room
- Figurant "patient" – in the bed (with intercom to test director)
- Patient safety specialist – in the ward room.

The tasks for each role are described in the simulation cases.

Simulation cases

For each scenario a role card with a precise description of every step during the simulation for each participant is completed. Initially, the purpose and target for the simulation is stated. After a presentation of the "patient", his disease, and present situation in the role card, the participant is guided through the scenario regarding her own role in the simulation. Description of the instruction for the used roles is shown in table 1.

Table 1 – Test scenarios

Role	Instruction
Educator	The vendor demonstrates use of the integration between the EHR and digital dictation.
Doctor	The doctor begins the hospital round and opens the EHR, partly to be updated of the patient's treatment, and partly to dictate via the EHR. He uses his User ID and password for the EHR.
Medical secretary	After the hospital round, the medical secretary starts transcription of the dictation from the EHR, and opens the integration using her User-ID and password for the EHR.
Figurant ("patient")	The patient is instructed to simulate e.g. pains or dyspnea, to conduct a live simulation. Via intercom the test director can give instructions to the "patient" during the simulation.
Test director	Surveys the simulation from the control room. Via intercom the test director can instruct the test coordinator during the simulation.
Test coordinator	Performs the simulation from the ward room, and supports the clinicians when necessary. Via intercom the test coordinator can communicate with the test director during the simulation.
Observers	Observe and note on check list or free text how the clinicians use the integration via the EHR and other situations related to the simulation.
Patient safety consultant	Same as the observers, but especially focused on patient safety issues.
Technical support	Makes video record of the simulation and documents the use of the applications (using the applications Camtasia and Real VNC).

The plan is to simulate two different scenarios, where clinicians test the solution with integration. The digital dictation application is activated from a button in the EHR.
In the first scenario, a doctor records a dictation during his hospital round, and is followed by transcription of the dictation to a record entry in the EHR by a medical secretary.
In the second scenario, the doctor summarizes a post-operative course, and becomes aware of an error in the record entry from the previous day, which he will correct, when he starts the dictation of the note and the epicrisis.
Planned interruptions from the "patients" are used to pursue similar, everyday situations in the clinic.
Afterwards, a medical secretary corrects the record entry, and transcribes the discharge summary.

Set-up

The simulation room is equipped like a common ward room. At the wardroom's entrance, there is a separate control room with one-way windows to the ward room. From the control room the test director can contact the test coordinator and the patient via the intercom, without disturbing the simulation.

Figure 1 – Photo from the control room with a view into the ward room.

During these simulations, a working station for the medical secretary is placed in the ward room (figure 2). By placing "the office" for the secretary in the ward room, we can monitor the workflow for the doctor as well as for the medical secretary, within the same set-up. The participants have permitted video recordings of the simulations for internal use. By recording the scenarios performed, it is possible to detect the interaction between the figurants, doctors, medical secretaries, and the CIS.

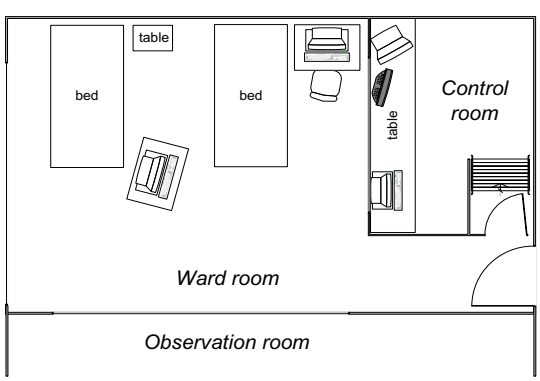

Figure 2 – Overview of the simulation set-up

From both from the control room and the observation room it is possible to observe the participants through the windows without disturbing the simulation. Regarding the performance of the simulation, the test director is able to guide the "patient", e.g. with a remark to the doctor.

Participants

To perform the simulations, we have included three doctors and three medical secretaries from different wards and hospitals in the Capital Region of Denmark.
They were engaged as common users of dictation, but with different profiles. Two of the doctors are surgeons and one is a pediatrician. Their roles are the same when they record a dictation. All the medical secretaries are skilled users of digital dictation and the EHR.
No special demands for their experience or enthusiasm for new applications was needed.
Furthermore there was participation from:

- Six members of the project group
- One member from the Unit of Patient Safety in the Capital Region of Denmark
- Two representatives from the vendors, who developed the integration between digital dictation and the EHR
- A medical student to manage the technical equipment in the control room

Their roles are described in table 1.

Both scenarios were conducted with a doctor and a medical secretary in three equal simulations, one in the morning and one in the afternoon over two days.
The time schedule (table 2) shows the time schedule for performing the introduction, the simulations, and the subsequent evaluation.
All of the participants participated in the evaluation at the end of the day

Table 2 – Time schedule for the simulations

Time	Activity	Location
Preparations		
8:30 – 8:40	Presentation of schedule, preparation and tasks	B2
8:40 – 8:50	Preparation of simulation room and control room	B3
8:50 – 8:55	Gathering up	B2
Simulation test		
9:00 – 9:05	Introduction to ITX-test(by test director)	B2
9:05 – 9:30	Introduction to the integration (by vendor)	B2
9:30 – 10:00	Test scenario 1 by doctor and medical secretary	B3
10.00 – 10:30	Gathering up with participants – potential adjustments	B2
10:45 – 11:45	Test scenario 2 by doctor and medical secretary	B3
11:45 – 12:00	Debriefing interview	B2
12.00 – 12.30	*Lunch*	The Café

Simulation test		
12:30 – 12:35	Introduction to ITX-test to the next participants	B2
12:35 – 13:00	Introduction to the integration (by vendor)	B2
13:00 – 13:30	Test scenario 1-2 by doctor and medical secretary	B3
13.30 – 14:00	Gathering up with participants	B2
14:15 – 15:15	Repetition of test scenarios	B3
15:15 – 15:30	Evaluation with all participants in the simulations	B2

As shown in table 2, the ITX method includes a debriefing with the participants and an evaluation of the performed simulations. The debriefing is particular in ensuring that the participant has been comfortable in the simulation role.
During the evaluation, the participants and observers, based on their impressions, check lists and notes, discuss the simulations performed.
The simulation was performed as planned with all six clinicians present during instruction, simulation, and evaluation. As figurants we used some of the observers.
Based on the simulations performed over the two days, the results and evaluations were analyzed and reported[2].

Results

By conducting clinical simulation, useful information regarding the new integration was obtained. Evaluation with the participants after the simulation showed the following concerns:

1. Patient safety issues
2. Functionality
3. Workflow
4. Usefulness

Patient safety issues

The most important result that the clinical simulation test demonstrated is that the EHR locks during use of the integration of digital dictation. Thus, it is impossible to use the EHR, connected applications or the digital dictation at the same time.

For instance, lack of admittance to laboratory information management systems might lead to incomplete information concerning the situation of the patient. Potentially, it will not only constrain the workflow for the doctor, but even jeopardize patient safety [15].

Another possible mistake might occur if the doctor, for a certain patient, selects the wrong relation, among several possible patient-contacts (e.g. a patient has a course in different wards) - the dictate will automatically be connected to the chosen relation. The medical secretary cannot change to the correct relation. Choosing a wrong relation might result in a loss of data, for instance, because the secretary cannot find the actual dictate.

During the project we have not focused on an emergency procedure. The simulations showed, however, the need for describing a workaround in case the integration does not work.

Functionality

The technical problem of the EHR application locking during dictation demonstrated that the new integration does not support the workflow of the doctors.

Furthermore, it became evident that the present solution does not support the entire workflow during transcription for the medical secretaries.

Workflow

Due to the integration between digital dictation and the EHR, it is not necessary to open both applications. The users found that the workflow is easier and more time-saving as the dictation-application is opened via a button in the EHR.

Under both dictation and transcription, it is not possible to navigate between different sessions.

Usefulness

The integration is easy to learn, and in general, the participants found that the solution is easy to use. For instance, it is simple to search and open a dictate. The instruction and the education materials were sufficient.

The dictation-application button on the EHR has a tape-recorder icon, and even though it is small, its function is intuitive.

Discussion

The purposes of the simulation were to determine potential errors and to secure quality assurance in change requests to the present application.
The preparations with the technical setup, test data, and detailed scenarios worked as intended. Interruptions – those planned in advance (in the scenarios) and those that occurred during the session – from the "patients" insured that the doctors had to search for additional health information during the dictation, which thereby demonstrated some lacks in the integration, regarding both technical issues and workflow.

The simulations showed that the integration between digital dictation and the EHR is easy to use. It supported the workflow during dictation, but not the entire workflow with common use of other applications.

Patient safety can be improved by linking the patient's unique identity number with the dictation and with the entry in the EHR. Complete overview of the patient's situation is another aspect in obtaining sufficient patient safety.

It is crucial to perform simulations out of the clinic with figurants to identify potential errors before implementation.

There is no advantage gained for the medical secretaries by using the present solution. The change requests, regarding transcription, have been identified during the project, but are not developed as of yet. The simulations support the necessity of developing these requests, before the integration can be implemented, to benefit the workflow for the medical secretaries.

Retrospectively, we can see discrepancy between the needs of the clinicians and the solution description. Some reasons are that the project has been delayed, and there has been change of

[2] The report and scenarios are in Danish and are available upon request.

project managers. Change of project managers led to loss of information and insufficient attention to the specification requirement and solution description.
Although we performed functional tests on the delivered application prior to the simulations, we did not identify the critical issues until the actual simulation test. The simulation gave us important knowledge relating to the complete workflow when using both applications.

The participants and observers gave a lot of useful information and feedback to the quality of the present integration between digital dictation and the EHR. Performance and results were the same at all simulations, independent of the participants and scenarios. The evaluation results are thus reliable and valid. The realistic settings are similar to other simulations performed in the ITX [13-14].

Conclusion

Based on the evaluation of the simulation the main issues for improving the integration between digital dictation and the EHR have been extracted.

The use of clinical simulation before implementation of new CIS-applications has visualized a critical issue in the application. Thereby, we have achieved one of the goals of the simulation. The results have been escalated, and the need for developing the necessary changes before implementation of the integration in the ward has been accepted. Conducting the simulations enabled us to improve the solution before implementation.

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Address for correspondence

Sven Koldby, sven.koldby@regionh.dk