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Preconditions for Implementing a Nursing App to Improve Digital Maturity

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Abstract. The aim of the paper is to conduct a formative evaluation and assess the implementation of a nursing app using the qualitative TPOM framework to outline how different socio-technical aspects of the process influence digital maturity. The research question is: what are the main socio-technical preconditions for improving digital maturity in a healthcare organization? We conducted 22 interviews and used the TPOM framework for analyzing the empirical data. Exploiting the potential of lightweight technology demands a mature healthcare organization motivated actors' extensive collaboration, and good coordination of the complex ICT infrastructures. The TPOM categories are used to show the digital maturity of the nursing app implementation in relation to technology, human factors, organization, and the wider macro environment.

Keywords. Digital maturity, nursing app, collaboration

1. Introduction

In Norwegian healthcare, existing ICT portfolios are dominated by large complex ICT solutions, such as electronic health records (EHR), and there is a growing need for innovation. Increasingly, lightweight ICT is entering the e-health field, supporting immediate user needs with simple applications e.g., apps This is potentially a paradigm shift for ICT infrastructures within Norwegian healthcare [1]. Thus, strategies for integrating such technology with the existing infrastructure are still scarce, and the sociotechnical knowledge of how lightweight ICT will affect users, clinical practice, and the overall ICT portfolio is largely missing [2].

As a first attempt to explore the feasibility of lightweight technology for supporting clinical practice, a nursing app for registering early warning scores (NEWS) was implemented by a Norwegian health trust in 2020 [3]. The app replaced paper forms and allowed for registering NEWS on mobile devices, and exporting data automatically to the EHR system. The overall goal for the health trust was to increase digital maturity in a socio-technical manner, including a mature organization, technology, and users [4].

The research question was: what is the main socio-technical preconditions for improving digital maturity in a healthcare organization?

The aim of this study was to conduct a formative evaluation based on interviews and

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observations and assess the data through the Technology, People, Organizations, and Macroenvironmental factors (TPOM) framework, Using this framework ensure capturing the tension between the dynamics, processes and interrelationships involved in technological change is considered, also, the progress and emerging risks of the implementations and which areas to focus on to ensure technology adoption [4].

2. Methods

This is a qualitative formative evaluation where the empirical data was collected a year after the health trust implemented the nursing app. The data collection included 22 semistructured interviews with 26 healthcare professionals, managers and vendors, observation of using the app, and meetings. The interview data were transcribed verbatim and analysed using the TPOM framework [4] to provide a broad overview of various stakeholder perspectives across four interrelated socio-technical dimensions: 1) Technological factors; 2) Social/human factors; 3) Organizational factors; and 4) Wider macroenvironment. Implementers can apply TPOM to any health information technology (HIT) project at any stage of implementation [4].

3. Results

The nursing app was implemented in 2020 to decrease paper use, explore mobile solutions for clinical settings, and simplify the work with NEWS. NEWS is important to detect and respond to clinical deterioration in adult patients and improving patient outcomes [3]. In this paper, we use the TPOM framework to outline four different socio-technical dimensions assumed to affect the overall implementation and adoption.

3.1. Technology - Integrations and Reuse of Data

The health region had a regional ICT organization, including an integration team, working in close relation with the app vendor to rapidly integrate the app into the existing portfolio. The app vendor designed and managed the app, including the user interface and functionalities. The regional ICT organization provided access control and the integration architecture. The regional ICT integration department said: *There is a large spiderweb of files and boxes that make the system (app) work, and every app implementation demands a new complex setup (leader Integration team)*. "This indicated that integrating apps at scale is a complex job. They did not think that a regional "app store" was realistic without rebuilding the entire integration services.

Another important precondition for improving digital maturity was the integration between the app and the existing EHR system, to which the app-generated data were exported. The app was built on flexible modern technologies easy to integrate into any format of standards. The health trust had a new EHR system based on open APIs, however, the system did not have the necessary structured forms to reuse vital signs within the EHR. Hence, the app had to connect to the EHR through a .pdf format which required cutting and pasting to reuse information in the EHR. The lack of digital maturity in the EHR limited the potential for data reuse provided by the app. While using pdf limit the potential for data reuse, the rationale was to create the momentum to proceed with the integration work and the collaboration. The ICT department leader said that if they had insisted on waiting for structured data reuse they may not have succeeded for years.

3.2. Social and Human Factors - Using the App for Clinical Practice

Nurses started to use the paper-based NEWS form in 2017, this was valuable for monitoring patient deterioration; however, the registration was time-consuming and demanded error-prone manual data handling and score calculations [5]. The ICT department worked for years to find a digital solution to improve this procedure and this nursing app was the most user-friendly and intuitive they found. Using the app for registering NEWS score was an overall success because the nurses found it instantly valuable, intuitive to learn, and easy to use. The nurses also highlighted the similarity between the app's interface and the existing paper form, the automatic calculation of NEWS, and transfer of the data to the EHR and the electronic whiteboards at all wards as important usability features. The app provided nurses with an overview of all the work with NEWS in the ward. This vastly improved their workflow and eliminated the need for double registration and demanding coordination work related to NEWS.

Still, some nurses listed barriers like using the mobile phone in front of patients, concerns about technical problems, or that patients found it impersonal and strange. They also worried that the focus on the digital work tool could risk compromising the clinical patient assessments especially for inexperienced nurses.

3.3. The Organization – A Mature Way of Running the ICT Infrastructure

The management in the health trust had worked to improve their ICT portfolio for years, and for every new solution implemented, they assessed the usefulness and alignment to the rest of the portfolio. They had been introduced to solutions for registering NEWS and vital signs before but found them to be both cumbersome and generate extra work for the nurses. They only wanted digital solutions generating benefits for the users. However, the technology did not have to be 100% perfect, *"The organization builds on an 80-20 approach related to technology maturity. When the technology covers 80% of the requirements we want, we start using it.. Waiting for the perfect solution often results in no solution at all (Leader clinical ICT department)."*

In the implementation, the management at the health trust led all processes both organizational, technological, and towards users. The regional ICT said: "*The health trust managers were highly motivated*." They had already started using mobile phones at the hospitals for patient-bed alarms as a first step towards improved digital maturity for their nurses. The EHR vendor said that the organization was agile and wanted to test technology to improve patient care, and the users were motivated to pilot and implement the solution and the decision lines were short from pilot to production. Still, the organization could not make all the decisions related to implementing the app by themselves, being part of a regional collaboration.

3.4. Wider Macroenvironment – the Regional Collaboration and Reuse of the App

We identified two important overall preconditions for digital maturity related to implementing the nursing app: 1) the regional ICT collaboration, and 2) the regional mobile solution. In this health region, most of the ICT portfolio was organized through a regional program where all health trusts collaborated on implementing the main clinical

systems (e.g., EHR and electronic medical charts). Small lightweight systems like apps were not included in the regional portfolio, which provided the health trusts with some flexibility. Still, the manager for the regional program underlined the importance of regional coordination: "*The role of the regional program is to provide regional systems and standards, but the four health trusts can make individual decisions on purchasing small system. Still, we must not end up introducing four different nursing apps in the region, that is counterproductive.*" The implementation of the nursing app was regionally approved and when this health trust had implemented the app, it was easy for the other health trusts in the region to do the same since they all used the same mobile infrastructure and integrations.

Using mobile units for the registration of clinical information demands a highquality mobile network and excellent Wi-Fi connections throughout the health trust. A regional system was recently implemented by the regional ICT organization. Testing out the quality of this system was both beneficial and a motivation for all parties.

4. Concluding discussion

Implementing apps to an existing ICT infrastructure is a new way of including innovative digital solutions for healthcare settings, and requires a multifaceted socio-technical interplay. To navigate this complex landscape with conflicting agendas and considerations, we used the TPOM framework. By analysing the empirical findings, we identified three overall preconditions for a successful implementation of a nursing app: usefulness, collaboration, and coordination.

First, the implementation was successful in fulfilling the goals of improving digital maturity in the health trust, including instant usefulness and improvement of the nurses' workflow. The app increased the digital competence of the nurses, who also discovered the potential for using the app for more purposes than originally intended. Moreover, the app enhanced the usefulness of NEWS also for doctors and leaders, given the integration between the app, the EHR, and electronic whiteboards. Second, the implementation of the app depended on extensive collaboration among the involved users. The app vendor had to collaborate closely to with the EHR vendor, the health trust organization, and the regional ICT organization to integrate the app into the existing ICT infrastructure successfully. It was important that all actors had a motivation of their own to improve digital maturity to make them invest the required time and effort to succeed with the implementation. Third, there is a need for coordination, to define and design standards for reusing data to exploit the full potential of the app. Vital signs are potentially reused several times within the EHR. The manual work and double registrations are not removed from the nurses' workflow, only moved a step ahead in the process.

In conclusion, the TPOM framework proved useful for analyzing the digital maturity of the nursing app implementation in relation to technology, human factors, organization, and the wider macro environment. The qualitative data provided insights into the complexities and success factors of the implementation process, illuminating its pros and cons effectively.

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