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Constructing Technology-in-use Practices: EPR-adaptation in Canada and Norway

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Abstract. Investigating two longitudinal ethnographic studies of managing gradual adaptation of electronic patient records in Canada and Norway, we conduct a cross-case analysis of the enabling factors that support a continuous transformation of technology and health care practices. In line with previous research, our study shows that large-scale information systems adaptation in health care should be managed by a project-group including not only IT-developers, but also representatives of future users and management. While we also argue for the importance of these meetings, we complement and expand the notion of project meetings by providing a conceptualization of the essential aspects of these meetings. Our conceptualization is composed of continuous reflection-on-practice activities to construct technology-in-use practices. Reflection-on-action activities are internally initiated, and comprise critical reflections by the participants, who continuously evaluate and question work practices in relation to technology.

Keywords. Electronic patient record (EPR), technology-in-use, reflection-on-practice, adaptation.

1. Introduction

The idea of computerized patient data that contain clinical information as recorded in the paper charts was introduced in the 1960s and 1970s [1]. For the last couple of decades, the implementation of Electronic Patient Records (EPRs) has been viewed as a highly challenging task. Among prevailing visions of what EPRs should be, are goals to make them into management tools that will be able to support managed care logistics, redesign of work processes, and improved quality of care [2]. Electronic patient records are expected to improve efficiency, coordination, and planning, and consequently, decrease costs and waiting times for patients. However, the transition to EPRs turned out to be an unexpectedly long and complex process where many goals have not been met yet. “Despite a series of heavily funded national and international

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initiatives, there is only very modest success in establishing working EPRs in large hospitals" [3]. Some of the existing myths about information systems implementation within health care are that an implementation is a technical realization of a planned system in an organization, that the implementation process can be left to the IT department, and that the implementation is merely a technical realization of a planned system in an organization [4]. There are many examples of technology implementations that have fallen victim to these myths. Meanwhile, the governments of countries such as Canada, the Netherlands, Norway, and the United Kingdom use extensive amounts of resources on implementation of information systems. Thus, we as researchers believe that it is highly important to conduct more research that is grounded in real cases studies, because these studies can assess the construction of alternative approaches for managing the complexities of information systems in the health care sector. It has been argued that EPR can deliver benefits only if there is an effective integration of the technology with localized work practices, while allowing space for ongoing adaptation and redesign [5]. We would therefore like to extend this argument and include the importance of having space for ongoing reflection-on-practice.

To construct alternative approaches, we must first consider our conceptualization of information system implementation. Adaptation, adoption, integration, implementation, appropriation, or acceptance, are all concepts which reflect on the process in which a technology is introduced and interlinked to the work practices in a particular setting. However the various concepts have different connotations. 'Adaptation' reflects on introducing, facilitating, and integrating technology into the work practices in a particular context. It refers to a process that changes both the technology and practice. Whereas the concepts of 'integration' and 'implementation' might indicate a primary focus of the technical aspects, 'adoption' or 'acceptance' might suggest that technology adaptation is simply a human choice and not a transformation process [6]. In this paper we view the interlinking process of technology and practice as adaptation emphasizing the transformation aspect. Thus, we follow a socio-technical approach and view the adaptation of information systems as a continuous process in which work practices and technology are influencing and are influenced by each other throughout a transformation and aligning process [e.g. 7, 8, 9].

In this paper we investigate two concrete cases of adaptation of information systems in the health care sector, and we propose an alternative strategy for managing the ill-structured and messy transformation process. Having access to rich empirical material from two longitudinal ethnographic field studies of managing gradual adaptation of electronic patient records (EPR), one in Canada and one in Norway, we have the unique opportunity to conduct a cross-case analysis of the enabling factors that support a continuous transformation of technology and health care practices. We explore the data material from these two cases by applying the concept of technology-in-use [10] to capture and represent the transformation process at different stages during the adaptation. We argue that one core challenge in the process of adaptation is to construct spaces for critical reflections and continuous evaluations of the work practices related to technology-in-use. We frame this alternative strategy as continuous reflection-on-practice activities constructing technology-in-use practices.

The paper is structured as follows. In section 2 we present the theoretical framework applied within the analysis, followed by a presentation of the empirical cases in section 3, and data material and research methods in sections 4. In section 5 we

conduct cross-cases analysis and in section 6 we discuss our empirical observations and offer final remarks.

2. Adaptation, Technology-in-use & Reflection

To understand the adaptation of complex technologies, we need to investigate the realities of introducing technology in specific organizational settings [11]. Technology adaptation is a transformation process in which existing work practices influence and are influenced by the technology. Such a process produces new situations that did not exist prior to the system, which in turn result in new transformed practices [7, 12]. Adaptation is an ongoing process of aligning practice and technology and is lead by disruptive events where the result is altered organizational structures [8]. We know that adaptation of collaborative technologies, such as EPR, requires more effort and commitment from the users than single-user systems [13]. Still, we know little about which factors or activities foster such commitment. However, success of adaptation has been found to depend on the malleability of the existing organizational work practices [8] and on how well the technology becomes embedded within the local context [14, 15].

Embedding technology in the context requires knowledge and understanding of the situated work practices [16]. Plans and situated actions are highly interlinked; however, when identifying structures of organizations in the process of embedding technology, one should assume that organizational structures are located in the situated actions rather than in the formal plans [17]. Making situated action visible in the process of adapting technology is thus an essential activity within technology adaptation. Initial planning of the adaptation process is important; however, one must recognize that it is impossible to predict and fully plan the socio-technical changes and the overall effect of the technology [2, 4, 18]. This unpredictability is due to the emergence of new possibilities and unanticipated patterns of use, that are brought along by the new technology [12, 19]. Thus, the impact of a new technology becomes emergent only in use [10, 18, 20]. Hence, the extent to which the system is used can potentially be much wider than initially designed for [22, 23]. This confirms the need for continuous reflection and re-negotiation of organizational work practices [24].

Adaptation of technology is highly influenced by people's perception of it [20]. Technology-in-use practice comprise peoples' understanding of how to use the technology on a daily basis and the consequences of such use [10]. Through the use of the technology, people have to reconsider their knowledge, which is based on experience, and their context-dependent practice of use. This is a dynamic and reflexive process where the technology is locally shaped and re-invented through the situated use, and an ongoing learning process where people try to configure ways of utilizing the technology [25]. This means that the fundamental purpose of technology adaptations in the health care sector is for the health care personnel to create and continuously re-negotiate technology-in-use practices while taking into consideration the situated actions. Re-negotiating technology-in-use practices requires spaces comprising reflection-on-action activities. Reflection-on-action refers to the activity in which health care personnel reflect on the experienced problems and articulate the strategies for actions which were implicit in the practice [26]. Thus, the purpose of spaces is for health care personnel to step back from their situated practices on different occasions during the adaptation process to critically evaluate and reflect upon their

technology-in-use practices and, on this basis, construct new technology-in-use practices for further development.

Previous research states that large information system adaptation projects should be managed by a project group, including but not limited to the IT department, which meets periodically to and negotiate system specifications and implementation plans [4]. Both of the empirical EPR-adaptation cases presented in this paper had meetings during the adaptation process; however, there were great differences between how these meetings were executed and how they were a part of the overall adaptation project. Thus, in this paper we complement and expand previous research by providing rich empirical data of the role and impact of essential meetings and conceptualize an alternative strategy for adaptation that encompasses continuous reflection-on-practice activities to construct technology-in-use practices.

3. Empirical Cases

Both in Norway and in Canada, implementation of EPRs has been on the political agenda for a long time, as these are viewed as 'magic silver bullets' that can be applied to solve the various financial problems faced in the health care sector. EPR implementations are affected by the health reform and are funded through national or provincial initiatives. The amount of money that is spent on such technologies is rather high, and so are the expectations.

The EPRs in our empirical cases were 'brought to life' to encourage a meticulous organizational transformation, which essentially focuses on achieving benefits that are measurable in financial terms. Hence, the initiative to develop an EPR was, to a large extent, formed by external pressure. Case A takes place in a large hospital in Norway where an EPR system was adapted to establish a common platform among the university hospitals. Case B takes place in a community health centre in Canada where the EPR was part of the renewal initiatives supported by the health authority. In both case studies, the infrastructure that existed before the EPR was highly complex and fragmented, characterized by loosely coupled systems existing on top of hybrid paper charts. Moreover, paper charts were distributed in fragments, were place dependent, and contained redundant information. These complexities provided poor and limited support for data integration and transfer across various health care organizations. Paper charts were also supported by various notebooks, binders, folders, and so forth. There were many different artefacts and various routines established to support the existing medical work practice. Fragmentation was also found in the technical infrastructure, which included in both cases several information systems (e.g., patient administrative systems, systems for laboratory results, patient registries in Excel sheets).

Even though there are many similarities between the two cases, there were also differences in some aspects, such as institutional structures, organizational size, and technical architecture of the EPR system. While we acknowledge these differences, we believe that by comparing the organization of the meetings guiding the adaptation process in these two different settings, we have the opportunity to provide important insights into the role and impact meetings have on the development of technology-in-use practices.

4. Method and Data Material

The data collection method applied to both research projects was longitudinal ethnography. Ethnographic research seeks to place the phenomena studied in a wider social context [5]. The primary focus is on acquiring rich insight and in-depth understanding of human, social and organisational aspects of the phenomena [27, p. 4], as well as understanding how these aspects influence, and are influenced by, the context [21]. Such a method is particularly good for generating interpretive knowledge because social phenomena and actors are studied in their natural settings. Conducting ethnographic interpretive research implies that reality is viewed as constructed rather than given and that there can be numerous interpretations of reality [28]. The overall aim in both studies was to gain a deeper socio-technical understanding of the situated work practices and the actual use of the EPR.

The fieldwork in Case A was initiated in October 2002 and lasted for one year, while the fieldwork in Case B began in October 2004 and is still in progress[2]. In both cases, the implementation of the EPR was followed from the initial phase of installation until the adaptation process had reached stability, but for our analysis, we will mainly focus on the first year of the adaptation process.

Similar techniques were employed for collection of the empirical data in the two cases. These included interviews and observations of activities. Open-ended, semi-structured interviews were conducted in different languages with various health care personnel (doctors, nurses, and secretaries) and IT staff (IT vendor and IT department) as well as with decision and policy makers. In Case A, these interviews were conducted in Norwegian and Arabic, while in Case B, interviews were conducted in English. All interviews were audio-recorded, fully transcribed, and carefully translated into English. To gain deeper knowledge about heterogeneous medical practices and to capture interactions that are inaccessible during interviews, they were supplemented with participant observations in various places, such as reception desks, charting rooms, and meeting rooms. The first author participated in several formal and informal meetings, such as medical team meetings for all the staff and clinical meetings for physicians, EPR meetings, and meetings with the IT department (or vendor). Various documents were collected, such as minutes from all the meetings, reports, memos, emails, and project plans. To become familiar with the two types of technologies adapted, the first author attended training sessions with health care personnel in each respective case, which included basic and advanced training sessions organized separately for each professional group.

Cross-case analysis was used for both cases [29, 30]. This included comparison of data material concerning the types of meetings held during the adaptation process in order to identify diversities and similarities between the management, execution, and impact of the reflective spaces. We primarily focused on the meetings held by the project managing group in each case. To identify how the technology-in-use practices evolved over time, we carefully re-investigated all the data material by applying the theoretical concept of technology-in-use. Having identified the technology-in-use practices within the two cases, it became clear that the meetings had different degrees of impact on the adaptation process in the two cases. Thus we re-examined the data

[2] This research is part of a large on going project called ACTION for Health, which studies the role of technology in the production, consumption, and use of health information.

material available from the two cases concerning the meetings and this lead to our conceptualization of continuous reflection-on-action activities.

5. Analysis: Identifying Technology-in-use Practices

We will now describe the adaptation process as it proceeded in Case A and Case B, providing in-depth descriptions from our empirical material as to how the technology-in-use patterns developed over time. It is not our intention to determine which case was more successful, after all, the EPR is still in use in both cases. Our intention, rather, is to identify which activities were supporting and driving the development of technology-in-use practices.

5.1. Technology-in-use Patterns in Case A

During the first few months, the health care personnel in Case A acquired elementary and basic knowledge about the EPR after attending a one-day training session. The adaptation process was lead by the IT-department, and both secretaries and physicians were supposed to start using the system on the same day. During this initial stage of adaptation, the IT-department conducted several introductory meetings with the various staff members.

Identifying the initial technology-in-use practices in Case A, the work practices, by and large, remained unchanged as physicians continued to dictate medical notes and hand them over to the secretaries for transcription. Upon completion, the secretaries printed out the notes and handed them back to the physicians who proofread the notes by marking corrections on the paper. They then handed the notes back to the secretaries who corrected the electronic version. Finally, the physicians would validate and sign the medical notes using the EPR. The work practice related to retrieval of information remained the same as before the EPR, and staff continued to use paper charts alongside with various books and folders.

After a period of time, new technology-in-use practices slowly emerged in some departments, and brought along organizational changes. Accordingly, physicians in these departments were now responsible both for transcribing and for correcting their own medical notes. However, there were no other major changes in the technology-in-use practice. Additional functions embedded within the EPR, e.g., electronic prescriptions and doctors' notes, were only used to a very small extent. In an attempt to encourage physicians to use these additional functions, some of the secretaries attended a training session and learned how to build templates for the physicians. However, the extent to which these additional functions were used remained minor. There were no radical changes, especially since the health care personnel were requested to keep both the paper charts and the electronic records updated. The secretaries therefore spent a considerable amount of time grooming and updating the charts by re-printing the recent versions of notes and by shredding the redundant ones.

The technology-in-use practices continued slowly to evolve, and after some time, the EPR was used not only for validating and signing notes, but also for retrieving patient data. Moreover, physicians gradually started using internal electronic referrals. The degree of use, however, varied between the different departments. Some physicians used it extensively on a daily basis, while others did not use it at all. In

addition, there were different work practices in each department, and while some physicians dictated the referrals, others typed the referrals by themselves.

After using the EPR for an extended period of time, the amount of print-outs grew dramatically and rapidly. Subsequently, there were crises in the hospital archive, both in terms of the lack of physical space and the increasing workload [31]. This led to discussions concerning the urgent need to start scanning paper charts, which, at that time, was viewed as a temporary ad-hoc solution for the existing hybrid information system. Several scanning strategies were discussed and piloted, but, due to various challenges, the implementation was postponed.

5.2. Technology-in-use Patterns in Case B

As in the previous case, the adaptation process in Case B began with one-day training sessions for the health care personnel. However, Case B, established a special EPR committee which was responsible for following the adaptation process, including the organizational changes needed during the process. The committee consisted of representatives from each professional group, and they conducted meetings on a weekly basis. Their aim was to discuss the various challenges and complexities that were faced, to evaluate the transition process, and to define new goals.

The initial technology-in-use practices in Case B comprised the secretaries' usage of the EPR for scheduling and billing activities. Physicians were slower in developing technology-in-use patterns and initially they used the EPR primarily for entering various medical summaries. They followed, however, a gradual adaptation process, beginning to use the EPR for one patient and then later increased the number of patients. Then not long after, some physicians began using the EPR for additional functions, such as writing prescriptions and using the search function (e.g., to retrieve the names of all diabetes patients).

The increased use of the system also triggered a discussion concerning the need to scan old paper charts (those belonging to inactive patients), thus making these records accessible electronically. Therefore, physicians became responsible for going through their charts and carefully selecting the most pertinent documents which they wanted to have accessible through the EPR. The secretaries then began scanning the documents and linking them to the corresponding chart. This meant that over time the physicians' technology-in-use practices were progressively changing. Their use of the EPR was gradually extended to include advanced functions, such as electronic billing and referrals. Moreover, there was an increasing interest in using additional templates, which led to more requests for designing new templates.

Paper charts were barely visible in the clinic anymore, and the health care personnel were increasingly motivated to "go paperless". Having this aim, the committee outlined a strategy for updating and integrating all the information into the EPR. This greatly affected the practices of cleaning up the patient charts. Thus, in contrast to Case A, where secretaries groomed the *paper charts*, in Case B, secretaries groomed the *EPR*. Since the physicians' workload gradually increased, the special EPR committee decided to redefine some of the existing roles and responsibilities. Accordingly, the secretaries were now responsible for updating the EPR. This implied going through each patient record and updating the narcotic agreement, and the allergy record, as well as information related to height, weight, and blood pressure. Since the secretaries had been scanning old paper charts for a period of time, there was an increase in the amount of information available through the EPR. This led the EPR

committee to implement a new policy whereby physicians were expected to stop asking secretaries to pull paper charts. They were now expected to retrieve most of the information from the EPR. In addition, the committee decided that there was no need for physicians to sign off on charts, since this was done through the EPR. In sum, the decisions and work practices related to the EPR changed so rapidly that our attempt to create a summary document that could capture these changes seemed profoundly challenging as it had to be repeatedly updated.

At this point, the number of challenges began to decrease and there was a sense of stabilization in the adaptation process. Secretaries were now responsible for shredding papers that were printed out from the EPR for faxing or mailing purposes. Some physicians started to use the advance function for writing quick referrals, which allows reuse of previously entered information. Graph and diagram-generating functions were also adopted by some physicians. The EPR committee developed a strict protocol for what the secretaries would be required to scan. The requests that were not approved by the protocol would be scanned by the physicians who were now provided training sessions.

5.3. Technology-in-use Practice Across Cases

We have now presented how the technology-in-use practices developed over time in the two cases. While we see that the practices around technology changed and evolved in both cases, we also observed that the extent to which the work practices changed was different. In Case A, the health care personnel did manage to adapt the EPR into their work practices and therefore develop technology-in-use practices over time. It is evident, however, that in Case B, the amount of changes were considerably greater, thus increasing the use of the EPR. In Case B, the health care personnel managed to develop highly complex technology-in-use practices over time. The below table summarizes the development in both cases.

Table 1. Technology-in-use practices in the two cases.

	Initial technology-in-use practices		**Emergent technology-in-use practices**	
	Physicians	Secretaries	Physicians	Secretaries
Case A	Validating and signing notes	Transcribing and correcting notes	Transcribing and correcting notes Retrieving information Partial use of prescriptions Partial use of doctor's notes Internal referrals	Piloting scanning Creating templates
Case B	Entering medical notes Prescriptions Search function	Scheduling Billing Scanning	Entering medical notes Retrieving information Prescriptions Search function Referrals Scanning Creating templates Partial use of visual graphs and diagrams	Grooming and updating the EPR Scanning

6. Discussion

We have now illustrated how the technology-in-use practices developed rapidly into more complex work patterns in Case B compared to Case A. In this section, we will investigate the factors promoting the adaptation process. Examining our empirical observations, we found that one of the major driving forces in Case B was the establishment of the EPR committee and their meetings. It was during these meetings that the health care personnel evaluated the adaptation process and continuously developed new and more advanced technology-in-use practices.

There were also meetings in Case A; however, these meetings took a different form and were organized by the IT department. Introductory meetings were mainly intended to introduce the various functions in the EPR. Follow-up meetings were conducted with contact personnel and 'super-users'[3], who were representatives from each professional group. Reaching consensus in these meetings was profoundly challenging because every time a new function was introduced, each group claimed their workload was already so high that they could not adopt these additional tasks. The staff from the IT department would often turn to the department head to ask for support.

In Case B, reaching decisions was radically different. Here, continuous discussions and negotiations took place with all committee members. Typically, when a new function was put into use, the committee members would request comments from the individuals specifically impacted by the change. This was often followed by a testing period where the new work practice was piloted. The committee would then request feedback on the pilot testing, thus evaluating whether the changes were feasible and/or beneficial. For example, when the committee discussed the need to fully update the EPR, they decided that it was not feasible to ask the health care personnel to enter all the information, as this demanded a considerable amount of time. Instead, the committee decided to prioritize which parts of the information should be entered. Hence, decisions were reached through a mutual and dynamic process of negotiation and re-negotiation of technology use [9, 24]. These meetings encouraged increased collaboration across professional groups, especially between physicians and secretaries. The committee meetings in Case B accumulated a process of continuous alignments, adaptations, and fine-tuning of local work practices to the technology (and vice versa). In situations where the workload evolved, new decisions were made based on new evaluations. Scanning, for instance, was initially conducted by the secretaries; however, as the number of requests increased, new strategies were established to distribute the workload between the secretaries and the physicians. The meetings in Case B enforced systematic evaluation mechanisms through iterative feedback loops. In Case A, when the IT department managed to reach a consensus and a final decision, the changes in the work practice were not always followed by the health care personnel. While the changes in Case A came from 'the-outside' ('the top level')- from the IT department who struggled with forcing changes the changes in Case B were initiated internally by the health care personnel. This can be viewed as a 'bottom-up approach'.

[3] 'Super-users' refers to a group of individuals that were expected to acquire more advanced knowledge and were assigned additional responsibilities (e.g. providing daily support to the staff, downloading updates, and informing the staff of any changes).

The meetings in Case B were very different in nature compared to Case A. The participants in these meetings did not constitute individuals that were randomly chosen to represent their professional group. Rather, the committee in Case B consisted of individuals who freely volunteered to participate in weekly meetings and dedicate some of their time to testing the EPR. It was therefore a group of committed and enthusiastic individuals who took responsibility for dealing with various challenges and actively defined new goals for further development. Since there were rapid changes applied to the technology-in-use practices, the committee acknowledged the importance of disseminating knowledge to all the health care personnel.

In contrast to Case A, where most of the meetings were held at the beginning of the adaptation process, the meetings in Case B were held on a weekly basis for half a year. It was only when there was a sense of stabilization and the number of challenges decreased that the committee changed their schedule to biweekly meetings, which were later reduced to monthly meetings. This allowed the health care personnel to deal with unexpected challenges as they emerged along the adaptation process. Such challenges and unanticipated uses could not be predicted in advance [22]. For example, usages of the messaging feature brought along challenges regarding how to deal with urgent messages in situations when the computer was turned off.

Thus, the weekly meetings in Case B constituted continuous reflection-on-action activities [26], which were essential for dealing with concrete, local, and situated complexities related to both the technical implementation and the necessary adaptation activities. Because of these meetings, technology-in-use practices were gradually emerging from situated actions [16]. Furthermore, the meetings in Case B provided space to engage in critical debates and question existing rigid and duplicated routines. An illustration of this questioning was when the secretaries at one point asked the physicians why they continued the routine of signing paper charts when this function was now conducted through the EPR. In other words, secretaries were questioning patterns of work that were a result of old habits.

In Case B, each new function was always discussed in relation to other existing functions. Hence, if a new function increased the workload for one professional group, it was always evaluated in relation to the overall context of changes. Decisions concerning changes in the distribution of practices were based upon the existing workload at a certain point in time. When the health care personnel discussed the need for updating the EPR, for example, the physicians suggested that the secretaries do this task since their workload decreased dramatically when they stopped grooming paper charts. Hence, the committee acknowledge the continuous changes in the amount of work and strived to balance the distribution of the workload among the staff. On the contrary, in Case A, each development of a new function was discussed in isolation from the overall context of changes. Hence, as mentioned earlier, when a new function was introduced, it was more easily rejected by the staff, who often saw the additional work tasks that were brought along with the new function.

The process of reflection was essential for enabling and assessing the management of the adaptation process and for cultivating technology-in-use practices. While, in Case A, the technology was viewed as something that took the practitioners' time and disrupted the medical practice, in Case B, new technical knowledge was articulated through use and influenced peoples' perceptions and understanding of the technology and its use [10]. Gradually, technology-in-use practices became embedded in the medical practice and were viewed as an important aspect for enhancing quality of care.

7. Concluding Remarks

Previous research found that large scale information systems adaptation in health care should be managed by a project-group including not only IT-developers, but also representatives of future users and management. They also found that negotiations of system specifications, as well as organizational changes, should be discussed frequently at project-group meetings [4]. While we also argue for the importance of these meetings, we additionally complement and expand the notion of project meetings by providing a conceptualization of the essential aspects of these meetings. Our conceptualization is composed of continuous reflection-on-practice activities constructing technology-in-use practices. Reflection-on-practice activities are internally initiated and involve critical reflections by the participants, who continuously evaluate and question work practices in relation to technology. Finally, it is evident that what distinguishes other meetings from reflection-on-action activities is that the participants take on the responsibility of bringing awareness of the new and revised technology-in-use practices to the professional groups. Our empirical observations suggest that participants' capabilities to provide awareness of new technology-in-use practices is dependent upon how well they are embedded within the local context of the work practices, which again is influenced by the engagement and commitment of the health care personnel. We found that our conceptualization of reflection-on-action activities was useful in explaining the differences between our two cases of EPR adaptation. Moreover, we hope this work will inform health care personnel as well as provide an analytical perspective enriching the existing research in the area of technology adaptation.

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