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Technology-Induced Errors and Adverse Event Reporting in an Organizational Learning Perspective

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Abstract. This paper addresses the possibilities of evaluating technology-induced errors, through the utilization of experiences of the Danish adverse event reporting system. The learning loop in the adverse event reporting system is identified and analyzed, to examine which elements can be utilized to evaluate technologies. The empirical data was collected through interviews and a workshop with members of the nursing staff at a nursing home in Aalborg, Denmark. It was found that, the establishment of sustainable feedback learning loops depends on shared visions in the organization and how creating shared visions requires involvement and participation. Secondly, care workers must possess fundamental knowledge about the technologies available to them. Thirdly comprehensive classification of adverse events should be established to allow for a systematic and goal directed feed-back process.

Keywords. Technology induced errors, adverse events, organizational learning

1. Introduction

Information technologies have increasingly been integrated in the work procedures in the Danish nursing sector. These technologies are implemented to support staff in the daily practice as well as taking over various nursing tasks hitherto handled by staff [1].

To prevent staff from making errors and to support patient safety, a large amount of standardized procedures is inscribed into the nursing practice. Another solution is the implementation of healthcare technology that assists health care professionals in their practice. When introducing new technologies, it is well documented that new kinds of errors can occur. These have been described as technology-induced errors, defined as errors "*... that inadvertently occur as a result of using a technology",* and "*arise from: a) the design and development of technology, b) the implementation and customization of a technology, and c) the interactions between the operation of a technology and the new work processes that arise from a technology's use*" [1, p.62]. These should be recognized and handled in order to maintain patient safety.

In many countries, an adverse event reporting system (AER-system) is used to identify, analyze and learn from errors that occur in the health care sector and in nursing practice [2]. To achieve the goal of learning from errors a feedback loop must be completed [3]. Any obstacle to the information exchange on the route from the occur-

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rence of an adverse event until the processed knowledge about the event has returned to the local environment will reduce or inhibit the learning outcome.
In this study we have mapped out the Danish AER-system and analyzed the flow of information to identify potential impediments. We have specifically focused on errors caused by or related to the use of technology and whether these can be processed as adverse events. The aim of the study was to understand the feedback mechanisms in the reporting system, to identify potential and actual obstacles, and possibly to design improvements to enhance the learning process.

2. Material, Theories and Methods

2.1. Material

The Danish AER-system facilitates a learning cycle on three different levels: within the municipal organization, among similar organizations in the Region, and on a national level [2]. This study focus on the internal municipal organization. A learning cycle starts with the reporting of an adverse event through an online platform. The staff in a local institution as well as clients/patient and patient relatives can report experienced or witnessed events. The reports are send to a risk manager who screens and categorizes the severity of the adverse event as: "no harm", "mild", "moderate", "serious", or "death". In case of "no harm", "mild", or "moderate" the case is categorized and closed by a decentralized caseworker, which could be the manager of the local health care institution. If categorized as "serious" or "death" the risk manager will initiate a root cause analysis. All cases are here after anonymized and send to the National Agency for Patients' Rights and Complaints where they are compiled to national statistics and published in an annual report [4]. The specific empirical field for the case study was a Danish nursing home, and the analytical focus was to understand the staffs' perception and initiatives related to organizational learning of technology. This knowledge was juxtaposed with the use and functions of the Danish AER-system. These two analyses were afterwards discussed in the context of E. Wenger's [5] stewarding competences and Peter Senge's [6] organizational learning theory.

2.2. Theoretical Background

AER-systems are complex system with contradictory interests among many actors, who all have to cooperate before the feedback loops can be closed, and for the AER-system to serve its purpose. Thus the theories of organizational learning provides ideas and concepts that are useful when elucidating and examining AER-systems.

For this investigation Peter Senge's [6] five disciplines for the learning organization and Chris Argyris' and Donald A. Schön's [3] theory of loop learning was utilized. Senge's five disciplines: *personal mastery, team learning, mental models, shared visions and systems thinking,* constitute a set of skills necessary to cultivate an organization's learning competencies. For this analysis, they were used as a tool for systematically analyzing the learning potential within the healthcare institutions.

To address the different levels of learning found within in the AER-system, the theory of loop learning was applied to investigate if and how the AER-system supports a learning loop, which allows learning on an organizational level rather than merely on an individual level. As this opens up for a breakdown of the various learning loops in

the AER-system, viewing the system in the light of loop learning allows for the identification and understanding of the best possible learning cycle.
By applying and identifying these loops within the AER-system along with Senge's five disciplines, it provides a way of systematically identifying insufficiencies in the AER-system's learning cycles and feedback loops. Thereby enabling the identification of areas that needs improvement and leads the way to finding constructive solutions.

2.3. Method for Data Collection

The study was conducted as a case study, and data was collected at a nursing home in Aalborg, Denmark. Due to privacy regulations, it was not possible to get access to reported adverse events or observing the AER-system in use. To gain insights into the use of the AER-system at the nursing home, interviews was conducted with six of the staff members, the nursing home manager, a representative for the municipality, and the local risk manager. The interviews were voice recorded and transcribed verbatim. Furthermore, we organized a workshop and observed a staff meeting where the topic was addressed. These were documented through field notes and posters with drawings and sticky notes produced by participants.

3. Results

3.1. Levels of Learning

It was found that different ways of acting upon errors that occur, affect the possible level on which learning can happen in the organization. The initial reaction from staff when noticing the error includes correcting the mistake and getting the situation under control, which entails single loop learning where only the involved staff learn about the specific situation. To reach a state of learning on an organizational level, double loop learning is necessary [3]. It entails reflecting upon why the error occurred and how this knowledge can be used to change the conditions in which the error happened. Reporting the errors in standardized ways like the AER-system as well as sharing the experience of errors with colleagues were found to be different ways of ensuring learning on an organizational level with their respective challenges.

We found that four main aspects were important in order to ensure learning on an organizational level: (1) accountability, (2) technological literacy, (3) a shared vision about the technologies in use and (4) dialog and discussions to establish shared visions and build new solutions. These became apparent in different steps of the reporting.

3.1.1. Reporting via AER-System

The present study indicates that accountability is a central embedded value in the system [7]. It was found to be pivotal in relation to both *pushing* and *pulling* healthcare professionals to utilize the system [8], especially in the first stage where the error is reported. Being obligated by law to report adverse events push the healthcare professionals towards reporting. A staff member explained how it also lead him to be more reflective about his work practice. Furthermore, the goal of being able to clarify and be upfront about errors and thus establish a basis for both local staff and others for learning from the errors pulls them towards reporting adverse events. Present day, the re-

porting of adverse events is primarily focused on events related to work practice, with only a few reported events concerning technology-induced errors. This could, to a great extent, be ascribed to the technological literacy of the reporting healthcare professionals.

Three types of staff at the nursing home were significant: regular staff, technology key persons and the nursing home manager. We found that the technological literacy for some challenged their ability to recognize the values and usefulness of healthcare equipment in the work of providing care for residents. For the manager it was obvious how the use of various healthcare technologies would improve the care provided to residents. The technology key persons had received extra training in relation to the specific technologies and some of those thereby also obtained an understanding of the advantages of the technologies in their work. However, several interviewed informed about a tendency amongst staff to deselect the use of the technological solutions in care activities when experiencing residents being nervous or uncomfortable, and so they refrained from pushing the residents into doing something they did not want to. A staff member explained: "I *think it is difficult to push residents to use the electronic toilets, if they do not like to use it*". She did not see the health related benefits of this encouragement, being greater than the discomfort of pushing the residents to use it.

3.1.2. Classification

Second step in adverse event managing is the classification of the event. Here the reported events are screened and analyzed by a risk manager who makes a judgment on what further actions are required.

A significant difficulty in classifying the reported events was the lack of proper description of the healthcare technology involved. The necessity of considering the technological literacy while evaluating and classifying the events, becomes central for the AER-system to fulfill its purpose. However, both the risk managers and the reporting staffs' way of thinking while evaluating must be changed, so the focus on technology as a possible actor in adverse events are considered. It was explained by the risk manager that, reported adverse events that does not involve a resident or patient, do not fit the criteria for being an adverse event, and will therefore be discarded. Hence the technology-induced errors with no obvious relation directly to a resident will not be detected and evaluated in the system.

3.1.3. Processing and Closing the Adverse Event Report

When processing and closing the reported events, organizational learning is carried on based on the classification. The caseworker who closes the event is responsible for sharing his/her experiences and enable the learning process. When striving towards learning from technology-induced errors, we found different aspects of organizational learning to be essential to keep in mind. "Key persons" assigned to various technologies were found to be a means of disseminating learning through a ripple effect at the nursing home. They are responsible for the training of other staff members in the use of the specific technology. Thereby also informing about the new possibilities the technologies bring about when providing care. However, it was found that the shared vision between key persons were challenged, in relation to what extra tasks and responsibilities the role implies. For instance, some key persons were highly committed to share their knowledge and enroll other staff members in the vision and explained the role clearly in interviews. A staff member explained the role to include: "*(...) having an*

overview, a positive approach to it [technology] and chemistry with both staff residents". Contrary others who had difficulties in acting as key persons and solely answered questions when asked for advice.

4. Discussion and Conclusion

This study addresses the learning potential of utilizing the AER-system in an organizational learning process. This naturally sets a focus on the process of reporting and ensuring feedback.

The feedback relies on individuals reporting the discovered events, and hence the engagement of the individual care worker to actually carry out the reporting of adverse events, is crucial. When the staff in the organization share the same vision and enthusiasm about the care work it will affect the reporting of adverse events. Shared visions in organizations often derive from the top, but it is essential to avoid forcing the visions upon the staff, but rather associate it with the personal visions of the staff [6].

According to Peter Senge [6] a learning organization should be able to share and accomplish such learning as a 'ripple effect' depending on both personal skills of the healthcare professionals and collective skills as an organization with a shared vision and strategy of learning.

Generating sense of accountability is a value to strive for in an organization as it can contribute to enhance reflection and thus continuous improvement and learning [7]. We found that a focus on technological literary and the role of technologies in the work practice is imperative in order to create a sense of accountability in relation to technology-induced errors. Encountering an omission to use a specific device or system should, in situations where it impairs the provided care, likewise be reported as an adverse event.

In summary, the establishment of sustainable feed-back learning loops is depending on shared visions in the organization. We found three fundamental challenges to create and maintain shared visions about how to deal with technology-induced errors. Firstly, the shared visions cannot be imposed on the care workers from the management – it must be created through involvement and participation [6]. Secondly, the care workers must possess fundamental knowledge about the technologies available to them. In our case study it is the responsibility of the technology key persons, however it could be organized differently. Thirdly, a comprehensive classification of adverse events should be established to allow for a systematic and goal directed feed-back process. Magrabi et. al have created a useful framework for such classifications [9].

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