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Smart Glasses in Nursing – Situation Change and Further Usages Exemplified on a Wound Care Application

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Abstract. Smart Glasses are a promising technology that can be leveraged to improve flexible service processes. Especially in the field of nursing where practitioners are facing complex tasks and challenges. Introducing such pervasive computing devices in service processes may have both positive and negative consequences. This leads us to the following research questions: How does the usage of the Smart Glass applications change the caring situation? Which ideas for future usage of Smart Glasses do nurses have? To answer these questions we followed a design science research approach to design a prototype for support of wound care management in nursing. We evaluated the prototype in a real life situation. Five nurses used the application in a real world setting to perform a wound documentation. Afterwards, we conducted semi-structured interviews with the nurses. The intent of the interviews was not only to get information on the current prototype, but to generate knowledge about dimensions of changing the caring situation which should be considered further. The nurses gave the application an overall positive evaluation. They stated that they would expect an improvement of the quality of the wound documentation when using the device. In addition, they mentioned a change in the communication structure with the patient would be necessary. Furthermore, opinions regarding further use cases did differ.

Keywords. Nursing, information technology, evaluation studies as topic

1. Introduction

Ongoing technological improvement of Smart Glasses offers promising new use cases and directions for the digitalization of flexible service processes. Furthermore, life expectancy in Germany and most other industrial nations is rising. Several challenges emerge from this that will have to be dealt with in the near future. These include political and societal changes in order to incorporate care for elderly people [7]. Another approach would be to support the daily work of nurses by supporting their working tasks through technology.

Usage of IT in nursing is already rising [6]. Thus, more and more digital data exists, which makes it easier to implement Smart Glasses. As one artifact of pervasive

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computing, introducing Smart Glasses may have positive as well as negative effects [3]. Prototypes for usage of Smart Glasses in nursing already exist [1; 4; 5; 9]. Scientific evaluations of current prototypes have primarily focused on prototype specific aspects. An evaluation of changings of the caring situation and of possible future use cases is missing. This leads us to the following research questions:

- How does the usage of Smart Glass applications change the situation of care giving?
- Which ideas for future usage of Smart Glasses in nursing do nurses have?

To answer these questions we designed a Smart Glass wound care application for nursing. Nurses could use the application and get first ideas about general usage of Smart Glasses in nursing. Afterwards we questioned the nurses.

2. Methods

In order to design a Smart Glass application to support nurses in their daily work, our research follows the design science research method (DSRM) [10]. We applied this methodology as follows: (1) We identified the problem in three workshops with nursing directors, nurses, IT specialists, a computer scientist and a nursing scientist. Resulting from these workshops was a list of possible use cases which were prioritized by feasibility and usefulness. One argument to implement a wound care application is that it is an independent process, which allows for implementation of a system without integration into existing software solutions.
(2) In subsequent workshops with wound managers and by conducting a literature search, we derived requirements for the artifact. One of the main requirements is the possibility to use the application hands-free. This guarantees a hygienic and time saving process. We implemented the application on the Vuzix M100.

(3-5) In a next step we developed an artifact iteratively. During the evaluation of the prototype it became clear that it is not effective to use the Smart Glass for all steps of wound documentation since typing letters is very cumbersome with Smart Glasses and the display size of the Vuzix M100 is very small. Because only the process of adding initial data of the wound to the system requires typing, but the majority of documentation time arises from daily documentations afterwards, we decided to divide the documentation into “initial documentation” and “continuous documentation”. Whereas the initial documentation should be completed on a tablet or any other device suited for convenient textual input, we decided to implement the continuous documentation on the Smart Glass. The application is described in the results section.

The artifact was evaluated in several stages of its evolution via workshops and qualitative interviews. The final evaluations of the application were performed with five nurses in two different nursing homes. To evaluate the application, the nurses received a brief introduction into the application. In a next step the nurses conducted a wound care documentation in a real life setting using the application. Data was not recorded. Afterwards, we conducted semi-structured interviews with the nurses and asked them about their experiences and further thoughts about Smart Glasses in nursing.

Whereas two interviews were conducted by a single interviewer (Nursing scientist), three were conducted by two interviewers together. For the evaluation of the interviews we conducted a qualitative content analysis. This analysis is useful to get systematized

and generalized results [8]. (6) As a last step of the design science research method we intend to communicate our results in future workshops.

3. Results

The elements of the continuous documentation which should be conducted on a smart glass are the following: affected tissue structure, length, width, depth, wound condition, wound exsudate, wound margin, additional symptoms, and wound assessment. The Smart Glass application used speech recognition to enable hands-free documentation. The item to be described was displayed with the relevant options. The options were assigned to numbers which the nurses used for the input. In a last step a picture of the wound could be taken by the command "take a picture".

Next, we describe the results of the final evaluation. Following our research questions we defined two codes deductively. These are "Change of the situation" and "Future usage". Furthermore, we defined the subcodes to these codes inductively. This leads to the following list of codes and subcodes.

Table 1: List of codes and subcodes.

Code	Subcode
Change of the situation	Proposed time savings
	Improved focus on the wound
	Contemporary documentation
	Disadvantage if device is broken
	Advantages of wound pictures
	Difficulty to communicate with the resident while treating the wound
	Enhanced communication between colleagues
	Patient can be informed before taking wound treatment
	Lost attention for the surroundings
	Communication can happen after taking care of the wound
Future usages	Training courses for nurses necessary
	Usage of Smart Glasses is a matter of habituation
	Expected acceptance of residents and nurses
	Rejection due to lack of understanding expected
	Acceptance is expected to be divided
	Usage of Smart Glasses during the whole working day is seen as infeasible
	Usage of Smart Glasses during the whole working day is seen as possible
	Smart Glasses with a reminder function could be useful
	Display of additional information could be useful (medication, therapy recommendations)
	Communication with physicians through Smart Glasses could be useful

The overall impression of the application was positive for most of the nurses. Whereas it became clear that using the application would change the process of the wound care management, nurses expected time savings due to the usage of the application. In addition, they mentioned a stronger focus on the wound during wound treatment. This aspect has several side effects. On the one hand, it enhances the quality of the documentation. On the other hand, it makes it difficult to talk to the resident while caring for the wound. However, some nurses came up with a solution for talking to the patient before or after caring for the wound. One example is displayed in the following quote which we translated to English:

„I think if you inform the resident in advance and he understands it, then you can make clear to that person that it's about a better healing of the wound, because you were able to do a much better documentation of the wound."

Future usage of Smart Glasses in nursing is seen as possible. Nurses mentioned training courses for the application as one important element of a successful usage of the application. There was no consistent common expectation regarding the acceptance of the application. While some of the questioned nurses expected a high level of acceptance, others expected divided opinions or even rejection of the application. We questioned the nurses about acceptance of the wound care application as well as about the possibility of wearing Smart Glasses during the complete working day.

„I can imagine the acceptance to be very high, if the colleagues are trained such that it can run smoothly. Than I could imagine that the colleagues would have fun using it and would really use it."

This quote illustrates that nurses find facilitated training sessions with the system important to improve technology adoption outcomes. Finally, opinions on the possibility of wearing Smart Glasses during the whole working day were mixed. It was seen unproblematic by some and infeasible by others.

4. Discussion

This exploratory research presents one possible use case for Smart Glasses in nursing and provides first answers to the questions:

- How does the usage of Smart Glass applications change the situation of care giving?
- Which ideas for future usage of Smart Glasses in nursing do nurses have?

Several aspects for possible changes of the caring situation, which should be considered in future developments, are illustrated. The main aspect mentioned is the missing possibility to talk to the patient during wound treatment due to the usage of speech recognition. Communication and appreciative behavior are important factors when providing care [2]. This seems to be clear for the questioned nurses as they reflected upon solutions to talk to the patient before or after treating the wound.

Nurses' feedback, that using Smart Glasses may improve the quality of the documentation focuses mainly on a timely documentation and on taking a picture. Taking wound pictures and conducting a timely documentation would be possible without using Smart Glasses. This shows that possible improvements due to the usage of Smart Glasses always depend on the actual implemented process.

The questioned nurses had some ideas for future use cases of Smart Glasses in nursing. Some could imagine wearing Smart Glasses the whole working day whereas this was not considered an option by others. The nurses mentioned the relationship to the patient as the most relevant factor. Data security or privacy was not mentioned. In contrast, these aspects are described as relevant in the literature [3]. Due to the small sample size we cannot claim completeness for the aspects mentioned relevant for developing applications of Smart Glasses in nursing.

Whereas we could get first results about possible changes of the situation and ideas for future usage, answers may be limited due to the example of one specific technology. It would be rewarding to repeat this research with further prototypes.

5. Conclusion

Our results show that using Smart Glasses for wound care management in nursing may change the situation in several ways. Nurses expect benefits regarding the accuracy of the wound documentation but also found communication with the patient more challenging. Nurses mentioned the possibility to talk to the patient before or after treating the wound. Regarding potential use cases for Smart Glasses in other nursing processes, differing opinions exist. Aspects to consider for future research are privacy and acceptance as well as the effects on the relationship between the residents and their nurse.

6. Conflict of Interest

The authors declare that they have no competing interests.

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