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Cognitive Performance of Users Is Affected by Electronic Handovers Depending on Role, Task and Human Factors

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Abstract. Patient handovers are cognitively demanding, crucial for information continuity and patient safety, but error prone. This study investigated the effect of an electronic handover tool, i.e. the handoverEHR, on the memory and care planning performance of nurse students (n=32) in a randomised, controlled cross-over design with the factors handover task and handover role. On a descriptive level, handover recipients could improve their memory performance with electronic support, handover givers their performance of writing care plans. Statistically meaningful differences occurred, however, only when the participants were givers. Without handover experience and with low fluency to word problems, givers performed badly in the most demanding of the handover tasks. Final recommendations, however, can only be made after replicating this study in a clinical setting with mixed groups.

Keywords. handover, electronic health record, memory, care planning, cognition

1. Introduction

Handovers are cognitively demanding [1], crucial for information continuity [2] and patient safety [3] but also prone to information corruption [4]. Although they form a specific clinical scenario of its own, they also share many elements with other clinical scenarios such as ward rounds and case conferences [5]. All these scenarios are challenging for information givers with regard to summarising the clinical case and presenting the information in a succinct manner as well as for information recipients with regard to understanding the clinical case and being able to make use of this information for patient care [5]. Handovers at the change of shifts are well-studied showing that handover performance depends on the handover experience [6] and on cognitive abilities to make clinical judgements [7]. Recalling the relevant patient information is one of the major prerequisites for making the right decisions and planning adequate clinical interventions [8]. As attention and perception precede any memory performance, the presentation of handover information becomes a vital factor as could be demonstrated by Hertzum and Simon [9], who installed wide screen monitors for use in handover situations. Based on these deliberations, an electronic health care record system for

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handovers, the handoverEHR, was developed, tested regarding usability and improved accordingly [10]. This study aims at investigating the effect of the handoverEHR on the memory and care planning performance of nurses depending on whether the information about the clinical case was presented in text form (list) or in graphical form (map). Furthermore, we were interested to study potential differences between handover givers and recipients and the effect of human factors that might function as confounding variables.

2. Methods

Study design. In order to achieve these objectives, a randomised controlled cross-over study was conducted, in which the following three experimental conditions were realised: a) handovers without any support (WITHOUT) (control group), b) handovers, in which the information was presented in lists that were generated by the handoverEHR (LIST), and c) handovers, which were supported by cognitive maps produced with the help of the handoverEHR (MAP), see Fig. 1. All study participants had to take part in all conditions both in the role of handover givers and as handover recipients. The participants were randomly allocated to one of the three experimental groups to start with. Thus these groups differed with regard to the sequencing of the experimental conditions in order to avoid a systematic timing effect. There was a wash-out phase of at least three months in between. The handover sessions took place in groups of four participants, who either handed over a patient (GIVER) or received the handover (RECIPIENT). As there were four patients to be handed over per experimental session, each of the group participants was a giver in one case and a recipient in the other three cases. The cases to be handed over were realistic and similar regarding the amount and complexity of information. This design, thus, entailed two factors with repeated measures, with handover task (WITHOUT, LIST and MAP) as first factor and handover role (GIVER and RECIPIENT) as second one.

Sample. A total of 32 study participants was recruited from a convenience sample of nursing students of the University of Applied Sciences Osnabrück in their third study year, who finished all three experimental phases. There were 23 females and 9 males with an average age of 22.04±2.69 years and 2.87±0.53 years of nursing experience.

Study protocol. All study participants answered a questionnaire with potentially confounding variables, i.e. age; experience in nursing (years), in handovers and in using an electronic patient record system; self-confidence, capability in handing over patients and fluency of writing care plans according to the nursing process. Participants in the LIST and MAP groups (Fig. 1) were given a one-hour introduction and training phase that included using lists, developing maps and presenting them on a 50” monitor. After each of the four handovers per session, the givers and the recipients wrote down the information items that they recalled. Furthermore, both givers and recipients developed a care plan for the incoming shift based on all information provided. The study took place in a lab environment to control for external factors.

Data analysis. In case of givers, items recalled were classified as correct, incorrect or missing with regard to the initial case description, in case of recipients, they were classified in comparison to what the givers actually said. The care plans of givers and recipients were compared to a gold standard care plan, which had been developed by a nursing expert (DF). In addition, the analysis of the recipients’ care plans considered potential information deficits of the recipients due to missing handover information.

Similar to the items recalled, the items in the care plans were classified as correct, incorrect or everyday knowledge of nurses.

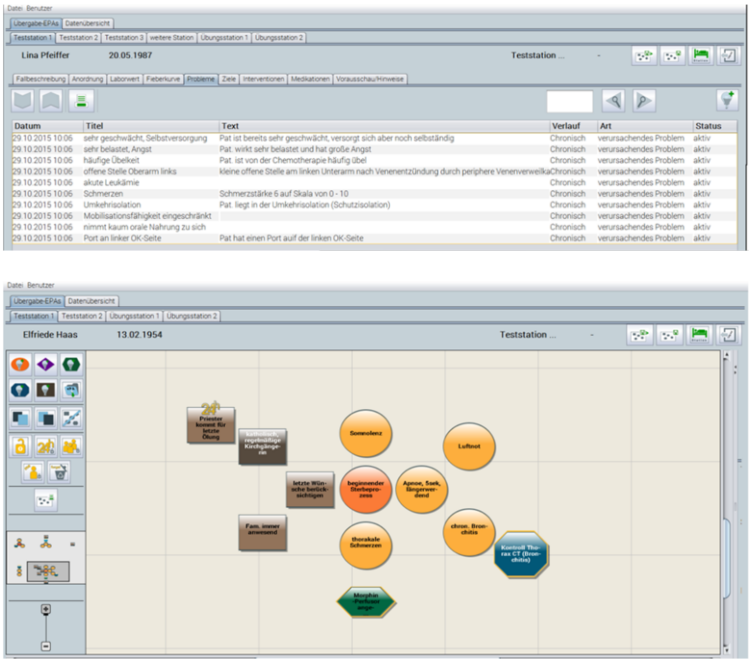

Figure 1: Screenshot LIST (above) and MAP (below). Circles denote problems and are associated with goals, interventions, medication and recommendations/advice [10]

As these classifications required expert knowledge, they were performed with the help of an independent nursing expert (GS). Data were analysed with the General Linear Model function integrated in SPSS Statistics Version 24. Alpha was set at 0.05.

3. Results

Memory. Table 1 shows the mean relative frequency of correctly recalled items for the two roles and the three experimental tasks. GIVERs received the overall best results when handing over information WITHOUT any help and the overall worst result when presenting the clinical cases as cognitive MAPs. In contrast, RECIPIENTs recalled items WITHOUT help much worse than GIVERs and increased their performance in the LIST and MAP condition compared to WITHOUT. This interaction between role and task was significant ($F(2;62)=6.78$, $p=0.002$), i.e. however, only GIVERs differed significantly (LIST vs. MAP and WITHOUT vs. MAP).

When differentiating between persons with handover experience (n=15) and no handover experience (n=17), the results revealed a significant interaction between handover type, role and experience ($F(2;60)=3.31$, $p=0.043$) as shown in Table 2. Again only GIVERs differed significantly, with experience between WITHOUT and LIST or MAP, without experience between LIST and MAP.

Table 1: Average percentage of correctly recalled items ± standard deviation ($n = 32$)

MEMORY		WITHOUT	LIST	MAP
Correct items	GIVER	56% ± 18	50% ± 18	41% ± 18
	RECIPIENT	46% ± 12	50% ± 11	49% ± 14

In most cases, persons without experience had lower values than those with experience (Tab. 2).

Table 2: Average percentage of correctly remembered items ± standard deviation ($n = 32$) for persons with handover experience, i.e. always or often (n=12) and no handover experience, i.e. seldom or never (n=17)

MEMORY	handover experience	WITHOUT	LIST	MAP
GIVER	yes	63% ± 20	44% ± 15	45% ± 16
	no	51% ± 17	54% ± 13	39% ± 20
RECIPIENT	yes	48% ± 9	52% ± 10	48% ± 14
	no	45% ± 15	48% ± 12	49% ± 15

Planning. There were no significant overall effects of the handover types, the handover role and their interaction on the relative number of correct planning items (Tab. 3).

Table 3: Average percentage of correctly planned items ± standard deviation ($n = 32$)

PLANNING		WITHOUT	LISTS	MAPS
Correct items	GIVER	89% ± 13	92% ± 11	89% ± 18
	RECIPIENT	88% ± 9	86% ± 17	85% ± 12

Breaking down these results for groups of persons who rated their own fluency to word potential problems as high (n=24) or low (n=8), showed a significant interaction between handover role and fluency ($F(1;30)=11.82$, $p=0.002$) and likewise a significant interaction between handover type, handover role and fluency ($F(2;60)=4.09$, $p=0.02$). A pairwise comparison revealed significantly higher values in the MAP condition for GIVERs with a high fluency than those with a low fluency.

Table 4: Average percentage of correctly planned items ± standard deviation ($n = 32$) for persons with high (n=24) and low fluency to word potential problems (n=8)

PLANNING	fluency	WITHOUT	LIST	MAP
GIVER	high	88% ± 14	92% ± 12	93% ± 12
	low	89% ± 11	93% ± 11	74% ± 27
RECIPIENT	high	88% ± 10	84% ± 12	84% ± 13
	low	92% ± 6	93% ± 6	89% ± 11

4. Discussion

This study investigated a) the influence of two types of electronic support on memory and care planning in handovers compared to no support and b) the influence of the handover role either as giver or recipient. The two types of electronic support differed with regard to the degree of novelty, complexity and visual support. The handover roles differed regarding the degree of using the handoverEHR actively.

The overall finding of this study was that the memory performance of GIVERs declined from the conditions WITHOUT, over LIST to MAP, while the performance of the RECIPIENTs nearly stayed the same. When planning, GIVERs benefited from the

MAP only when they were highly fluent wording potential problems. In the other case their performance deteriorated, which resulted in a significant difference in the MAP condition. This study included a homogeneous group of nurse students, which is both a strength (smaller variability) and a limitation (lower validity).

5. Conclusion

Analysed on a descriptive level, handover recipients can improve their memory performance with electronic support, handover givers their performance of writing care plans. Statistically meaningful differences occurred, however, only when the participants were GIVERs. Without handover experience and with low fluency to word problems, GIVERs performed badly in the MAP condition, the most demanding task. Final recommendations, however, can only be made after replicating this study in a clinical setting with age and experience mixed groups.

6. Conflict of Interest

The authors state that they have no conflict of interests.

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