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Electronic Whiteboards: Review of the Literature

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Abstract. Electronic whiteboards are being introduced into hospitals to communicate real-time patient information instantly to staff. This paper provides a preliminary review of the current state of evidence for the effect of electronic whiteboards on care processes and patient outcomes. A literature search was performed for the dates 1996 to 2014 on MEDLINE, EMBASE, IEEE Xplore, Science Direct, and the ACM Digital Library. Thirteen papers, describing 11 studies, meeting the inclusion criteria were identified. The majority of studies took place in the Emergency Department. While studies looked at the impact of electronic whiteboards on the process of care, there is an absence of evidence concerning impact on patient outcomes. There is a need for robust research measuring the impact of electronic whiteboards on inpatient care.

Keywords. Medical Records Systems, Computerized; Data Display; Evaluation Studies; Review

Introduction

Electronic whiteboards (EWs) are large electronic wall-mounted screens that display patient-specific information and/or information about the status of tasks related to the care of individual patients, making this information available to staff at a glance, and often replacing traditional dry-erase whiteboards [5]. Discussions with healthcare organisations suggest that EWs are increasingly seen as a tool to monitor and improve the quality and safety of healthcare, in part through effective distribution of information amongst staff. This paper presents a preliminary review of the current state of evidence for the effect of EWs on care processes and patient outcomes.

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1. Methods

1.1. Study inclusion criteria

Studies were included in the review if they described the impact of EWs on the processes and outcomes of care in hospital settings. The information displayed on the EW could relate to a single patient, e.g. in an operating theatre (OT), or to multiple patients, e.g. on a ward, and could also be accessible through other devices, e.g. desktop computers. Studies that described the use of EW software that is not displayed on a large screen but only accessible through other devices were not considered. We included studies that provided empirical (qualitative or quantitative) data on the impact of EWs on care.

1.2. Search strategy

We searched MEDLINE, MEDLINE In-Process & Other Non-Indexed Citations, EMBASE, IEEE Xplore, Science Direct, and the ACM Digital Library for the dates 1996 to June 2014. Search strategies used combinations of relevant free text terms referring to the technology (whiteboard, status board, interactive, electronic, digital) together with domain terms such as 'health' and 'medicine'. Due to limited time and resources, the search was restricted to papers in English and with an abstract. A hand search of the reference lists of relevant papers and reviews and a citation search of relevant papers were also conducted.

1.3. Study selection

All retrieved records were screened based on title and abstract. Full text copies of potentially eligible papers were retrieved and re-screened. A 'liberal accelerated' approach to both rounds of screening was taken, with one reviewer reviewing all records/retrieved papers and a second reviewer reviewing records/retrieved papers excluded by the first reviewer [10].

1.4. Data extraction, analysis, and synthesis

Data extracted included study design, sample type and size, setting, nature of the intervention and (where present) control condition, and any reported process or outcome measures. A narrative synthesis of the data was carried out, focusing on the contexts in which EWs have been introduced and the evidence for their impact on processes and outcomes. It was not appropriate to carry out a meta-analysis on the data due to the heterogeneity in interventions, processes measured and outcomes across the included studies.

2. Results

A total of 67 records were retrieved through database searching (47) and hand searching (20). Fifty-four were excluded, leaving a total of 13 papers, describing 11 studies, to be included in the review.

2.1. Study characteristics

Eight of the 11 studies used a before and after design [1-3; 6-9; 11; 15]. A mixture of data collection methods were employed, including routinely collected data [9], observations [11-14], monitoring of staff location and use of computers in patient rooms [7; 8; 15], measurement of noise levels [6], photographs and screenshots [2], and interviews [1; 12-14]. The majority of studies were conducted in the Emergency Department (ED). Two studies were conducted in the OT (alone or in combination with other areas).

2.2. Impact on care processes

Ten studies looked at the impact on care processes, such as the amount of time staff spent in patient rooms in the ED, staff mental workload, and interruption rates. Studies had mixed results. Two studies looked at the amount of time staff spent in patient rooms in the ED, using an ultrasound positioning system to track the location of staff every 20 seconds. One study found that the amount of time spent with patients increased for nurses but not doctors [7; 15]. The authors suggest that distributed access to the EW in patient rooms meant that nurses knew they are not currently needed elsewhere, reducing the need to regularly return to the coordination centre so that they could instead spend more time with patients. The other study found that doctors and nurses spent less time in patient rooms and more time near the EW, making little use of the distributed access to the EW, although they spent longer in patient rooms when they were there [8]. The same two studies also considered the impact of EW introduction on mental workload, using the NASA Task Load Index (NASA-TLX) questionnaire. Although no difference was found in the overall mental workload of the coordinating nurse [7; 15], doctors' mental workload increased during time outs (twice daily meetings where the doctors discussed all patients in the ED) following EW introduction, while nurses' mental workload at the start of shifts (when forming an overview of ED) decreased [8].

Interruption rates were found to be lower following EW implementation in an ED in comparison to earlier studies of interruption rates [4]. One study that looked at the impact of EW introduction on noise levels within two EDs [6] found that noise level was lowered at one site but not the other. The author suggests this was due to differences in size and layout of two EDs, which affected the benefit they derived from EW in terms of improved overview and therefore the extent to which it reduced the need for oral communication. A qualitative study in an ED found that EW introduction led to fewer transfers of information (distributed access to the EW meant the chief physician could enter initial patient information directly, rather than passing it on to the triage nurse to record), saving time and reducing the risk of errors or delays, and distributed access also meant that time outs could be held away from the control room, so as to not disturb work of the control room [13; 14].

Three studies, all undertaken in EDs, considered the nature and quality of information contained within EW compared to dry-erase whiteboards. Categories of information were similar but the frequency with which some types of information appeared substantially differed, with the information used to coordinate aspects of patient treatment more frequently found on the dry-erase whiteboards [2]. While dry-erase whiteboards have been found to contain fewer inaccuracies than EWs [12], where the EW automatically records certain information, introduction of the EW eliminates

digit preference bias (the preference for recording particular values, typically values ending in '0' or '1', when recording data) in recording the timing of events, resulting in more accurate data [9].

In one study in the OT, OT utilisation increased from 82% to 88% following introduction of the EWs (although the authors do not state whether this was statistically significant), with utilisation 15% higher in those OTs using the EW than in those where the EW had not been implemented, and the likelihood of an operation starting when scheduled increased by 50% [1]. Where the EW in the OT was used to support the pre-incision time out (for verifying patient identity and the surgical plan, while also providing team members with an opportunity to voice concerns and establish contingency plans), with key information about the case and a checklist with checkboxes for time out displayed on the EW, the introduction of the EW resulted in a significant increase (36.1%) in overall time out compliance with core time out elements [11].

2.3. Impact on patient outcomes

While some of the positive impacts on care processes described above could be assumed to lead to improvements in patient outcomes, only one study, undertaken in the ED, looked directly at patient related outcomes, reporting a decrease in patients waiting in the 4-6 hour range, an increase in patient satisfaction in emergency and urgent care, and a decrease in patients who left without being seen [3].

3. Discussion

The aim of this preliminary review was to assess the current state of evidence for the effect of EWs on care processes and patient outcomes. This review reveals that existing studies have been undertaken in the ED and the OT, but there is an absence of studies that consider the impact of EWs in inpatient settings, despite the increase in use of EWs in such settings. There is also an absence of studies that consider the impact of EW use on patient outcomes. While positive impacts on care processes have been identified in surgical settings, studies in the ED report mixed results.

Such mixed results are unsurprising, given that EWs are a complex intervention, made up of a number of components and implemented in myriad ways. There is variation in how the technology is introduced, how work practice is adapted in response to EW introduction, what information is displayed on the EW, whether that information is automatically or manually updated, and how that information is displayed. Consequently, not only is there a need for robust research measuring the impact of EWs on the processes and outcomes of care in inpatient settings, it is also necessary to understand more clearly in what circumstances and through what processes EWs give rise to both intended and unintended outcomes. This would enable the creation of guidance for healthcare organisations on the technological, organisational, and social components that need to be in place for the greatest patient benefit to be achieved. To obtain such understanding, future studies of the impact of EWs need to clearly describe the technology, data sources, data displays and interactivity, using screen dumps if possible, and also clearly describe the staff using the technology, their training, the implementation process and for how long the technology was in use prior to the study being conducted.

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