

The Distributed Use of Electronic Emergency-Department Whiteboards

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Abstract. At emergency departments (EDs), electronic whiteboards are introduced to provide a better overview and to support clinicians in spending more time with patients. Often, the main difference between electronic and dry-erase whiteboards is that electronic whiteboards provide distributed access to whiteboard information. We investigate the distributed use of whiteboards at one ED by analyzing seven months of log data. Distributed use is far most frequent among the secretaries, indicating that whiteboards serve multiple uses. The physicians and nurses make little distributed use of the whiteboard and when they do it is to prepare for seeing and to document having seen a patient, rather than in patient rooms with the patients. Important reasons for the limited distributed use among physicians and nurses appear to be a frequent need and practice of visiting the physical information hub of the ED. The information hub features a permanent wall-mounted display of the electronic whiteboard and this display, rather than distributed access, is preferred by physicians and nurses.

Keywords. whiteboard, emergency department, distributed use, system adoption

Introduction

Coordination and overview are important to the work at emergency departments (EDs), which receive unpredictable numbers of acute patients and must be able to prioritize and treat them safely and efficiently. The support for coordination and overview has long included ED whiteboards with frequently updated information about the patients [1-3]. Currently, many EDs are replacing their old dry-erase whiteboards with electronic whiteboards [4,5]. As part of their support for coordination and overview the electronic whiteboards provide distributed access to whiteboard information from any computer in the ED, and it is often a supplementary goal of this distributed access to support clinicians in spending more time with the patients. Conversely, the information on dry-erase whiteboards is tied to the physical location of the whiteboard, and ED clinicians must visit this location to get the information. This study investigates how one ED makes use of its newly acquired distributed access to whiteboard information.

Electronic ED whiteboards may potentially serve as the primary information portal in EDs [1,6] but to fulfil this role the whiteboards must be integrated with the other electronic ED records, and this is often not yet the case. Instead most electronic ED whiteboards must to a considerable extent be updated manually by ED clinicians and are similar to dry-erase whiteboards in layout and content. The main difference between these electronic and dry-erase ED whiteboards is the presence or absence,

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respectively, of support for distributed access. Yet, ED clinicians report high levels of satisfaction with their electronic whiteboards [5,6]. This makes it important to understand how ED work benefits from distributed access to whiteboard information.

The studied electronic whiteboard is permanently available on large, wall-mounted displays at the information hub in each of the ED areas and it is, in addition, accessible from any computer in the ED. When a patient is announced for ambulance arrival, the coordinating nurse enters preliminary patient information on the whiteboard. Walk-in patients are received and announced by the secretaries. Upon arrival, patients are seen by a nurse and triaged to determine the urgency of their complaint. The coordinating nurse enters selected triage information on the whiteboard, including the triage level and any tests ordered. Also, a physician is allocated to the patient. Physicians often monitor the whiteboard to align their examination of a patient with the arrival of test results. Whereas all ED staff gets information from the whiteboard, most whiteboard updates are made by nurses, particularly by the coordinating nurse. This study lasted from two months before the introduction of the electronic whiteboard until it had been in use for five months. We aim to better understand the impact of distributed whiteboard use on ED work practices, coordination, and the time spent with patients.

1. Methods

The ED at which the study took place was part of a medium-size Danish hospital and consisted of a fast-track area for walk-in patients, two acute areas, and a long-term area. The study specifically concerned the acute area reserved for the patients triaged at the two highest levels (i.e., the most severe cases). This area had seven beds. The electronic whiteboard was taken into use at the ED in early May 2011 after a preparation phase that consisted of configuring the whiteboard, informing the staff, and consulting the ED at a nearby hospital that had recently introduced the same ED whiteboard. New work practices involving the whiteboard were not strictly enforced but rather allowed to emerge. This study was approved by the management of the ED and by the healthcare region's department for quality and development.

Data were collected by logging the use of the computers in the studied ED area for a period of seven months. These 18 computers formed three groups: The clinicians had access to eight computers in the hallways. These computers were used for preparing to see patients, looking up information before finalizing patients, and documenting the condition and treatment of seen patients. The clinicians also had access to computers in six of the seven patient rooms for purposes similar to those for the hallway computers. We excluded one of the patient-room computers from our analysis because it was replaced during the study, resulting in incomplete logs. Finally, the secretaries had five computers in their shared office. These computers were used for maintaining an overview of the current work at the ED, recording newly arrived patients, and completing the documentation of patients about to leave the ED.

A tailor-made program was installed on each computer and continuously logged the active application, if any. If the same application window remained active for an unbroken period of more than 10 minutes followed by the onset of the screen saver, we assumed the application was unattended during the last 8 minutes of the period and discarded them. If an application window still remained active for an unbroken period of more than 15 minutes, we recorded only the first 15 minutes as application use. The logs contained no information about who used the applications.

2. Results

We logged the use of 18 computers for two months before the electronic whiteboard was introduced (March and April) and for five months of whiteboard use (May through September), a total of 3827 days of log data. These data capture the distributed use of the electronic whiteboard and do not include the computers that permanently show the electronic whiteboard on the wall-mounted displays.

Figure 1 shows the data. We distinguished between five types of applications: (1) *Electronic whiteboard* (EWB), which provided overview information about the patients currently admitted or announced to arrive. (2) *Electronic patient record* (EPR), which enabled documenting a patient's current admission and looking up information about previous admissions. (3) *Test results and images* (Tests), which provided access to the results of tests and other examinations ordered by ED clinicians. (4) *Treatment instructions* (Instr), which gave the procedures prescribed for patients with a specified problem or presumed diagnose. (5) *Other*, which comprised all remaining applications.

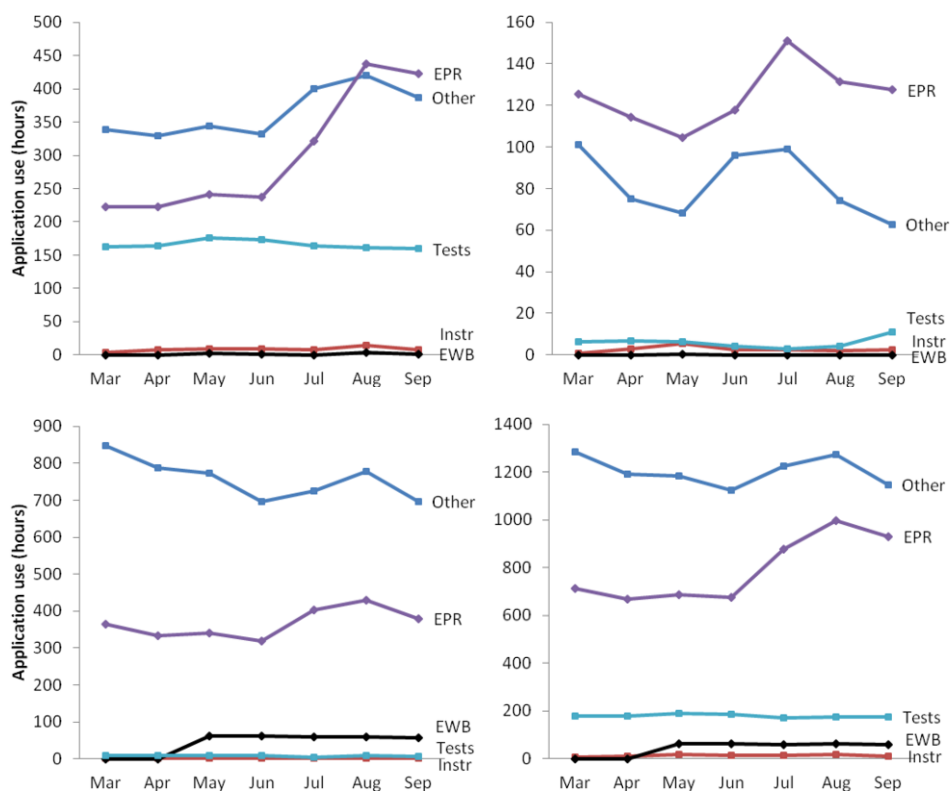


Figure 1. Hours of monthly application use for hallway computers (top left), patient-room computers (top right), secretary computers (bottom left), and in total for all 18 computers (bottom right).

A multivariate analysis of all the data shows a significant effect of time, Wilks' $\lambda = 0.56$, $F(30, 346) = 1.82$, $p < 0.01$, indicating that application use evolved over the period from March to September, and a significant effect of location, Wilks' $\lambda = 0.10$,

$F(10, 22) = 4.86, p < 0.001$, indicating differences in application use across hallway computers, patient-room computers, and secretary computers.

For the electronic whiteboard, we found no change in the number of hours of monthly use in the period from its introduction in May through to September ($ps > 0.9$ for all pairwise comparisons of the months May to September). Figure 1 shows that the electronic whiteboard was mainly used by the secretaries ($M = 60.3$ hours/month). The clinicians' average monthly use of the electronic whiteboard on the hallway computers in the May-September period ($M = 1.0$ hours/month) was significantly different from the non-use in the March-April period before introduction, $F(1, 7) = 10.09, p < 0.05$. Conversely, the average monthly use of the electronic whiteboard in the patient rooms ($M = 0.04$ hours/month) merely approached a significant difference from non-use, $F(1, 4) = 5.12, p = 0.09$.

Treatment instructions were used for significantly more hours a month after the introduction of the electronic whiteboard than before, $F(1, 17) = 7.55, p < 0.05$. The use of treatment instructions increased significantly at the hallway computers ($M_{\text{before}} = 5.6$ vs $M_{\text{after}} = 9.7$ hours/month, $p < 0.05$), approached a significant increase in the patient rooms ($M_{\text{before}} = 1.8$ vs $M_{\text{after}} = 3.1, p = 0.09$), and unsurprisingly remained low and unchanged at the secretary computers ($M_{\text{before}} = 1.1$ vs $M_{\text{after}} = 1.9, p = 0.3$).

For the three remaining application types, that is EPR, test results and images, and other applications, there was no change in hours of monthly use before compared to after the introduction of the electronic whiteboard, $F_s(1, 17) = 0.79, 0.01, 0.19$, respectively (all $ps > 0.3$). The absence of differences for these application types provides some evidence that work at the ED was not changed considerably by other factors in parallel with the introduction of the electronic whiteboards.

3. Discussion

The distributed use of the electronic whiteboard is mainly by the secretaries. The extent of this use was not planned but emerged as an efficient way for the secretaries to maintain an overview of the occupancy level of the ED, to inform walk-in patients about waiting times, and to keep track of patients' progress toward discharge in order to know when their records had to be finalized. Previously, the secretaries had to get such information orally from the clinicians or to walk over to the dry-erase whiteboard. This tended to be cumbersome because the clinicians would normally be busy with their patients and because the four areas of the ED had separate physical information hubs. In their shared office, each secretary has a workspace with a computer and they perform most of their work at this computer. This facilitated their adoption of the electronic whiteboard as they were already in front of a computer, logged on, and could keep the whiteboard running in a background window or open it in a matter of seconds. The secretaries' use of the whiteboard shows how it supports multiple professional groups and purposes; this artefactual multiplicity [3] spawns distributed use.

In contrast, the physicians and nurses make little distributed use of the electronic whiteboard on the computers in the hallways and, especially, the patient rooms. This does not imply that they disregard the whiteboard information, but that they predominantly access it from the wall-mounted displays dedicated to the electronic whiteboard. These displays are located close to the patient rooms and the information hub of this ED area. In addition, informal interviews indicate that senior ED clinicians with managerial responsibilities also access the electronic whiteboard from their offices

and, occasionally, from home. The near-zero use of the electronic whiteboard in the patient rooms combined with the absence of an increase in any other use of these computers suggest that the electronic whiteboard failed in enabling the clinicians to spend more time with the patients by moving some preparations for seeing a patient and some documentation of having seen a patient to the patient rooms. A partial explanation for the failure to achieve this effect concerns missing integrations. For example, the electronic whiteboard actually contains a facility for integrating the whiteboard with the ED's treatment instructions, thereby easing access to the instructions relevant to each patient's complaint. This facility must, however, be configured by the ED and the effort required to do this was never made. The somewhat cumbersome access to the treatment instructions without the whiteboard integration probably made the clinicians feel more comfortable accessing the instructions from a hallway computer before seeing a patient than in the patient room with the patient. For the clinicians, who are constantly moving from one location – and computer – to another, integrations with other systems appear necessary to make distributed use of the electronic whiteboard worthwhile. Also, the less experienced clinicians need to consult other clinicians, and the physical information hubs provide good opportunities for this to happen as well as ready access to the wall-mounted whiteboard displays.

The number of monthly hours of distributed use has remained unchanged since the introduction of the electronic whiteboard, suggesting that the current level of distributed use is robust in the sense that little organizational implementation is required to achieve it. However, it also suggests that the ED has engaged in little experimentation with new ways of working to make the most of the opportunities provided by distributed use. It is not unusual that the window during which work practices are adjusted to make the most of new systems is brief [7]. This calls into question the ED's implementation strategy of allowing new work practices to emerge because this strategy may reduce the value derived from the electronic whiteboard. The ED management must consider taking a firmer grip on the implementation process but it is uncertain whether they are ready to do so. Distributed use of electronic ED whiteboards is technologically trivial but it is a major new possibility compared to dry-erase whiteboards and it is not yet fully comprehended and utilized by EDs.

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