

Can teamwork and situational awareness (SA) in ED resuscitations be improved with a technological cognitive aid? Design and a pilot study of a team situation display



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ABSTRACT

Effective teamwork in ED resuscitations, including information sharing and situational awareness, could be degraded. Technological cognitive aids can facilitate effective teamwork. Objective: This study focused on the design of an ED situation display and pilot test its influence on teamwork and situational awareness during simulated resuscitation scenarios. Material and methods: The display design consisted of a central area showing the critical dynamic parameters of the interventions with an events time-line below it. Static information was placed at the sides of the display. We pilot tested whether the situation display could lead to higher scores on the Clinical Teamwork Scale (CTS), improved scores on a context-specific Situational Awareness Global Assessment Technique (SAGAT) tool, and team communication patterns that reflect teamwork and situational awareness. Results: Resuscitation teamwork, as measured by the CTS, was overall better with the presence of the situation display as compared with no situation display. Team members discussed interventions more with the situation display compared with not having the situation display. Situational awareness was better with the situation display only in the trauma scenario. Discussion: The situation display could be more effective for certain ED team members and in certain cases. Conclusions: Overall, this pilot study implies that a situation display could facilitate better teamwork and team communication in the resuscitation event.

1. Introduction

The Emergency Department (ED) is a critical and complex work environment consisting of people, devices and tools, actions and events. Studies have shown that effective teamwork in the ED is key to patient safety [1,2]. One of the important aspects of teamwork is Team Situational Awareness (TSA). TSA is a meta-construct referring to cognitive processes involved in team members acquiring and sharing situational information and knowledge about the situation. This includes team and task-oriented information and the mutual understanding of it [3,4]. TSA is more than the aggregated knowledge across team members [5], and is also the interactive team processes such as communication and

collaboration that allows shared knowledge to be constructed and maintained among team members [6]. By having effective teamwork processes, TSA is improved and maintained, thus ensuring that every team member is well aware of what is happening, and who does what and when.

However, there are many research findings indicating obstacles to effective teamwork in the ED such as interruptions and distractions, and even physical environmental factors such as noise [7–9]. Verbal communication is probably the most common factor that is recognized as critical to effective teamwork, and communication breakdowns and degradation of information sharing are often attributed causes for adverse events and medical errors [10,11]. Communication breakdowns

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can thus be associated with degradation in situational awareness as well. The question is: what can mitigate communication breakdowns and TSA degradation, and thus improve patient safety and ED teamwork?

One of the ways to address the problem of optimizing team communication and TSA is to develop and employ technological cognitive aids. Specifically, a large information display shared among team members is one such cognitive aid. The objective of a situation display is to present a current and dynamic situation picture to the team. This can be done by merely displaying all the information on a single large display, or by integrating the information and presenting only what is critically required by all team members [12,13]. Some evidence that displays support teamwork have been shown in various domains and applications such as military command-and-control [14–16], aviation and air traffic control [12,17,18], naval ship command [19,20], and urban firefighting [21]. In healthcare contexts, shared displays can provide clinical information [22–30], or information to support scheduling, administration, and process management [31–35].

Most published work on large team displays describes the design and development of such displays, or their deployment. Yet, there are studies that assessed and tested the effectiveness and impact of such displays. For example, Fitzgerald et al. [22] used a large display to support trauma teams and assessed the impact on clinical outcomes of 1171 trauma patient resuscitations with a randomized control study design in real patient care settings. They found a significant reduction in error rates, particularly in the first 30 min of the resuscitation.

The significance of demonstrating improved clinical outcomes is essential to validating the need for and efficacy of large team displays in critical care. Yet, it is as significant to study also possible factors and constructs that may mediate the impact of such displays on clinical outcomes. Specifically, to study the designs of team displays aimed to improve TSA, and demonstrate their influence on teamwork, TSA, and communication, which in turn influence clinical outcomes. To this end, this study assessed the effectiveness of a team situation display by using a large situation display to support information sharing, TSA, and teamwork in the ED team during resuscitations.

2. Objectives

The long-term goal of the study is to improve ED resuscitation teamwork and TSA, and ultimately improve clinical outcomes and patient safety patient safety. We pursued this goal by designing an ED situation display and pilot testing its influence on teamwork and situational awareness. Specifically, the study aimed to determine whether teamwork and SA are improved using the situation display versus no display during simulated ED resuscitations.

To describe this study, the paper consists of two main parts:

1. The ED situation display design;
2. The simulator-based study of the display effectiveness.

3. Materials: Display design

3.1. User research

We interviewed 18 resuscitation team members about the roles and goals of team members and their patterns and topics of their communication. We also observed 30 video recordings of simulated resuscitation training of residents, and documented communication source, destination, and information category. The recordings were of standard scenarios used for both training and certification, and are thus sufficiently generalizable. Finally, we observed 12 live resuscitations and recorded the type of resuscitations, nature of teams, and content of information exchanges.

The analysis of the gathered material from all three sources followed the methods described in previous studies [27,36]. Briefly, we

followed an iterative qualitative data coding approach whereby meaningful communication segments were identified and coded by two criteria: the speech act (such as questions and answers), and the clinical-specific category (such as patient status or intervention). Emergency physicians from the research team subsequently prioritized the clinical-specific categories by their criticality to the clinical procedure and relevance to several team members. This resulted in a list of high-priority clinical information categories that should be shared among team members in the ED during a resuscitation event.

Based on the analysis, six primary and high-priority ED resuscitation information categories emerged: 1. Patient history; 2. Current patient status; 3. Present team members and roles; 4. Assistance and consults; 5. Interventions (codes, medication management, tests, treatment); and finally, 6. The events time line. These information categories served as the basis for designing a situation display for the resuscitation team in the ED.

3.2. The display design

Key principles of a User Centered Design approach were implemented. These included an iterative process from a conceptual design through to a final detailed design. The iterations involved feedback from users representing the different clinical and healthcare professions in the ED. We conducted two focus groups to receive users' feedback on the evolving display design. In the focus groups, participants viewed the display design at that point and provided feedback about the overall layout, the content, and the specific displayed parameters. The comments and suggestions were considered in both the conceptual and detailed design of the display.

The conceptual design was aimed at determining the key information to be displayed and how to lay it out visually. We followed the methodology described by Parush [30,27,36] that was implemented in the design a situation display for the cardiac operating room team [27]. Determining the key information to be displayed was based on the original priorities assigned to information items, and on users' feedback during the focus groups. Patient-centered information about interventions and tests emerged as the most important and key information. This patient-centered key information was translated in the design to “the patient-in-the-center” visual layout solution. Specifically, this key information was placed in a central location that would support effective and efficient visual search, attention allocation, and focus during the procedure. All other information was placed around that center and towards the periphery of the display (see Fig. 1). This design approach is different from other designs that tend to be more process-centered (e.g., [31]) or treatment algorithm-centered design (e.g., [22]).

An additional design objective was to clearly separate this important and dynamic information from other information that was

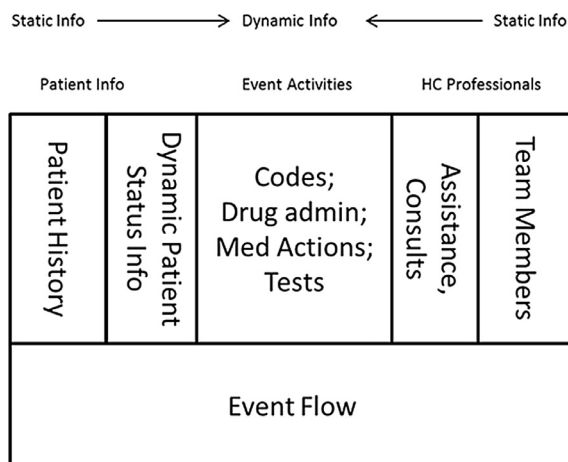


Fig. 1. Conceptual design for the ED resuscitation situation display.

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