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Implementing Real-Time Computerized Clinical Decision Support During Trauma Resuscitations: Lessons Learned From Simulation.

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IMPLEMENTING REAL-TIME COMPUTERIZED CLINICAL DECISION SUPPORT DURING TRAUMA RESUSCITATIONS: LESSONS LEARNED FROM SIMULATION

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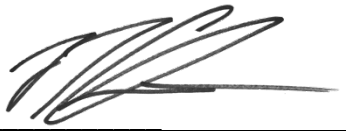
Signed: 

March 29, 2019

Implementing Real-time Computerized Clinical Decision Support During Trauma Resuscitations: Lessons Learned from Simulation.

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Introduction

Evidence-based practice (EBP) combines clinical experience, research, and patient values to eliminate variation in healthcare performance. The implementation of EBP has led to improvement in quality of care through reduction in hospital length of stay, complications, waste, and healthcare costs. Yet, despite growing evidence supporting EBP, healthcare providers have been slow to implement EBP into their practice. Previous studies have demonstrated a lack of time, access, training, and support to be the leading barriers to implementation of EBP (Konrad, Tulu, & Lawley, 2013; Osheroff et al., 2012; Sadeghi-Bazargani, Tabrizi, & Azami-Aghdash, 2014).

To improve the use of EBP, healthcare organizations need to ensure that evidence is immediately available during patient care and accessible through an easy to use format. Evidence demonstrates clinicians do not have time to digest a body of evidence during emergent care; thus, the need for a prepackaged delivery method is required (Andermann, Pang, Newton, Davis, & Panisset, 2016). Computerized clinical decision support (CDS) software brings relevant information to the bedside by providing patient specific information to assist in making clinical decisions (Osheroff et al., 2012; Van de Velde et al., 2016). With the release of Medicare and Medicaid Stage 1 *meaningful use* requirements, hospitals and healthcare systems have been implementing computerized CDS programs as part of computerized provider order entry (CPOE) (McCoy, Thomas, Krousel-Wood, & Sittig, 2014). In response, current research on CDS systems has focused primarily on alerts during CPOE where information during the order entry process is collected through additional pop-up windows; few CDS systems utilized situational awareness or followed diagnostic patterns (Miller et al., 2015). Through the

use of CDS during CPOE, researchers have improved adherence to medication ordering guidelines, decreased the number of unnecessary laboratory and imaging studies, and decreased unnecessary blood transfusions (Dayan et al., 2017; Jenkins et al., 2017; White, Hamilton, Pegues, Hanish, & Umscheid, 2017).

Methods

To facilitate best practice at the bedside in an American College of Surgeons (ACS) verified level I pediatric trauma center, we are implementing an iOS based electronic medical record (EMR) interface that will replace the current paper trauma resuscitation record. The software, called T6, was developed by T6 Health Systems and provides computerized CDS alerts through linked documentation fields to triggers on EBP algorithms. The internal EBP algorithms were developed by their internal medical staff based on review of current literature, personal practice knowledge, and guidelines from the Eastern Association for the Surgery of Trauma (EAST) and Western Trauma Association (WTA). EBP algorithms are mapped to clinical documentation triggers and real-time analytics that continually assess data and activate alerts as appropriate. Alerts appear by two different methods, disruptive and non-distributive. Non-disruptive alerts appear on the screen similar to receiving a text message on an iPhone, a white number inside a red circle appears on the alert icon at the bottom of the screen, providers can click on the icon when they have time during the resuscitation. Disruptive alerts appear the same as non-distributive with the addition of an alert box that opens in the middle of the screen. In order to the close the box the provider must click on view, to view the algorithm, snooze, or dismiss (M. Hameed, 2018). During the implementation process, we were faced with many decisions on how to properly implement T6. We elected to

develop a feasibility study, which utilized in situ trauma simulation to test T6 in the trauma environment. Simulation has been successfully used by researchers at Harvard to test the impact of surgical-crisis checklists (Arriaga et al., 2013) and our facility has a trauma in situ simulation program which hosts regular simulations events.

In 2017, our center participated in an EAST multicenter trial evaluating simulation in trauma education. We obtained permission from the study's primary investigator to use our center's data to represent our current standard of care. For the multicenter study, the primary investigator developed a standardized pediatric traumatic brain injury (TBI) scenario. As the scenario progressed the patient would decompensate, develop *Cushing's* response and, eventually, suffer from bradycardic arrest if proper care, including definitive airway management, administration of fluid resuscitation, and neuroprotective agents were not administered in a timely fashion (Jensen et al., n.d.). Each participating institution ran the same simulation a total of three times during the study period. For the current study, we ran the same simulation an additional four times using T6, two without disruptive alerts and two with disruptive alerts; the number of sessions was limited due to implementation timeframe. The simulations were in situ and the team did not know they were responding to a simulation. All were activated as level I trauma teams consisting of pediatric surgery attending, pediatric emergency medicine attending, anesthesiology, pediatric surgery fellow, two pediatric emergency medicine fellows, chief surgery resident, surgery intern, three emergency department RN's, emergency department patient care tech, pharmacy, respiratory therapy, and emergency department assistant nurse manager.

Analysis

This was a feasibility study to evaluate the potential impact of CDS during pediatric trauma team resuscitation. Since this was a feasibility study, there was a minimum number of simulation sessions completed, thus only descriptive analysis was used for comparison. During the simulation, data was collected on time to intubation, time to RSI induction, time to treatment with mannitol or 3% normal saline, time to operating room (OR) notification, and time to head computerized tomography (CT). Decision to move to CT was used as the trigger to end the simulation.

Facility goal for time to completion of primary survey is one minute, simulation completion time ranged from one to six minutes. Two teams (25%) completed primary survey in one minute or less, one with decision support turned on and the other was from baseline cases (figure 1). Timing of completion of primary survey varied across all seven simulation sessions ranging from one minute to six minutes, CDS alerts did not have an impact.

The scenario used called for a definitive airway to be placed, with failure to do so triggering patient decompensation. Time to intubation ranged from five to eight minutes, one patient during baseline testing was not intubated and the team placed an LMA (figure 2). Anesthesia provided intubation during the fourth session and had difficulty with the manikin, the scenario did not call for a difficult intubation and this was related to provider not being familiar with simulation equipment. During the sixth simulation session the team failed to identify respiratory distress and the patient progressed into bradycardia with a rhythm less than 60 beats per minute. The team elected to start compressions and follow pediatric advanced life support (PALS) algorithm, simulation

team increased heart rate to redirect the team. The decision to follow PALS delayed the time to definitive airway. Variability of time to completion of intubation spanned all simulation sessions, CDS alerts did not have an impact.

Need for emergent care of the patient was identified through the notification of the OR prior to completion of secondary survey. Discussion by care teams took place during multiple sessions regarding the need for a CT prior to moving to the OR. Notification took three to eight minutes with no notification being made during the sixth session (figure 3). Post notification of OR teams completed secondary survey, ranging from five to eleven minutes from arrival of patient (figure 4). In three sessions the team did not voice completion of secondary survey, no time was recorded for those sessions. With 42% of data points not captured it was difficult to analyze, of data available there was not impact on time to completion.

During all sessions the teams identified the need for management of traumatic brain injury to include early initiation of hypertonic saline or mannitol infusion. Timing to infusion ranged from four to nine minutes, timing was equally distributed across all three groups (figure 5). Our facility standard is to infuse mannitol in TBI, four (57%) of the groups used mannitol as the primary choice. During session two, mannitol was administered, and hypertonic saline was ordered, and in session three, hypertonic saline was administered, and mannitol was ordered.

Management of TBI varied during all seven simulation sessions, four patients received mannitol and two received hypertonic saline. In two simulations, the opposite treatment was also ordered but not administered, from review of simulation footage it is

not clear why the medication was not administered. Analysis demonstrated deviation from facilities standard management with mannitol. During video review, a clinician was overheard stating that hypertonic saline is our facility's standard, which further highlights the need for bedside tools to help compliance with best practices.

Decision to move patient from trauma bay to CT was used to trigger end of the simulation, time to head CT ranged from seven to fourteen minutes (figure 6). During the second session, the simulation was ended after 15 min by the simulation staff as the team was not moving the patient to CT. The fastest and longest times to CT were observed while using T6, suggesting speediness was more related to team leader and team dynamics.

Discussion

Goal of this study is to help guide further implementation of T6 at our institution and within the health system. We are currently in the early stages of implementing T6 within our institution; at this time about half of the emergency department nurses have received documentation training and only a brief introduction to the product has been provided to surgeons. We did not want nursing comfort with T6 to impact resuscitation so technical support was available in person to eliminate this variable. We are implementing T6 in stages. In the first stage, we are only going live with RN documentation while physician documentation is planned for a later implementation. Because of this, formal physician education on navigation and documentation in T6 is planned for a later date. From this study, we have learned that, regardless of using the physician documentation component, training needs to be provided to the surgeons regarding disruptive vs non-disruptive

alerts, how to access alert information, and how to access built in checklists for patient care. Side note, during the sixth simulation session, a Pediatric Surgery Fellow stated he would have liked to have known how to access the checklists earlier, as he found them helpful during room preparation and patient resuscitation. In addition to adding physician education we will increase nursing education to include more simulation training and will make several iPads available in training mode for practice.

As part of the implementation process, the T6 software has undergone review by multiple groups throughout our organization. An initial impression from the nursing informatics team is that there were too many disruptive alerts, which impacted the ability of nurses to document patient care. In response, disruptive alerts were turned off within the system. During the first simulation scenarios which were run using T6, it was quickly identified that, despite a small indicator at the bottom of the screen, clinicians did not have time during resuscitation to constantly review what alerts had been triggered. At the end of both sessions, the surgery team commented that disruptive alerts for major care components would have been helpful and they expected those alerts to appear on screen. For the final two simulations, we turned the disruptive alerts on; the team leaders stated this was helpful in notifying them of care guidance, although, some of the alerts were not necessary. This fits with current literature, which demonstrates that the majority (49% to 96%) of alerts within EMR systems are ignored by providers related to alarm fatigue (McCoy et al., 2014). Future work is needed on reviewing the current disruptive alerts within the system for appropriateness to facilitate best practice without physician alert fatigue.

Although no significant difference was noted with the use of T6, with or without disruptive alerts, additional training and product familiarization is needed for successful implementation and evaluation. This has been discussed with the primary investigator from simulation study and there is an interest in incorporating T6 alerts into future multicenter simulation studies to measure impact on standardization of care.

Conclusions

Early research in the use of computerized DCS has demonstrated that it is capable of providing guidance equivalent to that of a senior trauma trained surgeon in adhering to care standards set forth in the Advanced Trauma Life Support Curriculum (Clarke, Cebula, & Webber, 1988). More recent research demonstrates the ability of bedside computerized CDS to provide care recommendations based on best evidence for the management of severely burned patients (Cancio, Salinas, & Kramer, 2016). Although this study identified changes needed for successful implementation at our institution, further research is needed to measure impact on implementation of best evidence. We are currently in the process of fully implementing T6 and plan to continue conducting simulation sessions to gather additional information. Furthermore, we are discussing this project with the EAST multicenter study to gauge the interest of conducting a follow-up study using T6 at multiple centers. Post full implementation, data will be gathered for comparison on impact of best practice during actual patient care.

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