Computer Integrated Surgery II Background Reading Report
Group 23
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Project Summary:

Our project is the "Creation of a Novel Real-time Communication Solution for Timely Sepsis Management." Sepsis is the body's extreme reaction to an infection, and it is a main cause of global morbidity and mortality, with peak mortality occurring in pediatric and elderly patients. Since sepsis attacks the body so quickly, immediate antibiotic administration is of the utmost importance. Children who receive antibiotics within one hour have, on average, a shorter hospital length of stay and shorter in-hospital mortality rate. Though it is known that identifying sepsis early and treating patients within one hour is critical, the Johns Hopkins Hospital does not currently meet this standard. After speaking with Dr. Fackler and other attending physicians at the Johns Hopkins PICU, it is evident there is a communication issue when it comes to treating children with sepsis, with different team members being unaware of when the antibiotics have been delivered to their location.

Our goal is to find a viable solution to this problem and be able to successfully provide IV antibiotics within an hour to children diagnosed with a serious bacterial infection. The following process map in Figure 1, developed by Chen Wang, will be used to assist in developing a physical prototype of a communication solution. Our eventual goal is to implement a program in which we can display the augmented process map on a monitor in the hospital, with certain areas highlighted to show where the antibiotic is currently located. This will allow all team members to see where they currently are in the sepsis management process as well as allow the relevant team members at each location to receive timely alerts, so they know when it is their turn to act.

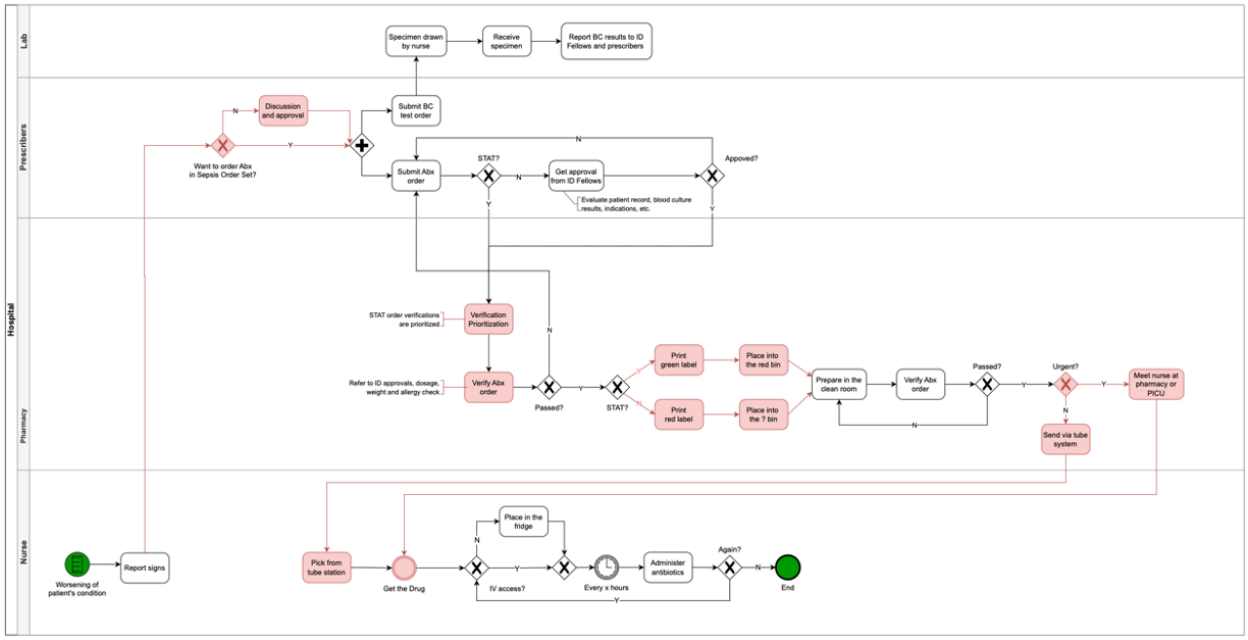

Figure 1: Process Map

Paper Selection:

In this report, the paper "*The impact of a multifaceted intervention including sepsis electronic alert system and sepsis response team on the outcomes of patients with sepsis and septic shock*" will be summarized [1]. The paper has multiple authors, including Yaseen M. Arabi, Hasan M. Al-Dorzi, Ahmed Alamry, Ra'ed Hijazi, Sami Alsolamy, Majid Al Salamah, Hani M. Tamim, Saad Al-Qahtani, Abdulaziz Al-Dawood, Abdellatif M. Marini, Fatimah H. Al Ehnidi, Shihab Mundekkadan, Amal Matroud, Mohamed S. Mohamed, and Saadi Taher; and it was published on May 30, 2017, in the Annals of Intensive Care Open Access Journal. The paper discusses the implementation and effects of using an e-alert system alongside a sepsis response team to treat sepsis. The latter part of our project includes finding the best way to alert relevant personnel when it is their turn to act. We had initially discussed building a physical device with a buzzing capability. However, there may be a simpler solution. Understanding the paper reviewed in this report is a key step for the success of our project as it explores the possibility of notifying personnel via the hospital's electronic alert system.

Necessary Background:

To better understand this paper and report, there is some sepsis knowledge that should be explained.

Sepsis is a potentially life-threatening condition that occurs when the body's response to an infection causes organ dysfunction or failure. The management of sepsis involves a sepsis resuscitation bundle, which is a set of evidence-based interventions aimed at improving the outcomes of patients with sepsis. The following are measures included in the bundle that were mentioned in the paper.

- Measuring lactate levels within 6 hours of sepsis recognition
- Obtaining blood cultures before antibiotic administration
- Administering broad-spectrum antibiotics within 1 hour of sepsis recognition
- Administering 30ml/kg crystalloid for hypotension or lactate $\geq$ 4 mmol/L
- Administering vasopressors for hypotension that does not respond to initial fluid resuscitation to maintain mean arterial pressure (MAP) $\geq$ 65 mmHg
- Re-measuring lactate levels if initial lactate was elevated
- Achieving central venous pressure (CVP) $\geq$ 8 mmHg or central venous oxygen saturation (ScvO2) $\geq$ 70% if initial lactate was elevated and persistent hypotension despite fluid resuscitation

This paper uses an e-alert system and SRT to identify and treat sepsis. The e-alert system is an electronic system designed to identify septic patients in a timely manner, while the sepsis response team (SRT) is a specialized team responsible for the management of septic patients.

Summary of Goal, Key Results, and Significance:

A lack of communication among sepsis response team members can impede the team's ability to provide efficient and effective care. One of the reasons for this lack of communication is that team members may not be clear on when it is their turn to act. In a high-stress situation like treating sepsis, team members may assume that someone else is taking charge or that they are not responsible for a particular task. This can lead to confusion, delays in care, and potentially life-threatening mistakes. In addition, because the team is composed of healthcare professionals from different departments, this can further complicate communication. This paper suggests that using a multifaceted approach, an e-alert system with a sepsis response team, can have a synergistic effect and help with communication.

Because sepsis is a complex and time-sensitive condition, the authors of this paper recognized that treating sepsis requires more than just implementing a single intervention. Their multifaceted intervention had two components: the electronic alert system and the sepsis response team. By implementing this multifaceted intervention, the authors aimed to improve communication and coordination among healthcare providers, enhance the timeliness and appropriateness of interventions, and ultimately improve patient outcomes. The study showed that this approach was effective in reducing mortality rates, ICU length of stay, and hospital length of stay among septic patients.

This paper showed that implementing an electronic sepsis alert system in our project can help improve the timeliness of sepsis management. Notifying relevant team members when a patient is identified with sepsis would allow for prompt evaluation and treatment. Also, the paper's findings suggest that combining an electronic sepsis alert system with a sepsis response team can further improve patient outcomes by providing an opportunity for healthcare providers to work together and exchange information. This is valuable information for our project because we can now consider incorporating a similar electronic alert system into our solution that triggers alerts to a sepsis response team. This could involve creating a secure group chat in the electronic system that would allow the SRT to coordinate care and ensure timely intervention.

Technical Summary of the Paper:

2.1 Electronic alert system

The electronic alert system discussed in the paper was a computerized system that identified patients with suspected sepsis in real time based on vital signs, laboratory values, and clinical criteria. The alert system was triggered when a patient met two or more of the SIRS criteria

(systemic inflammatory response syndrome) and would automatically notify the sepsis response team (SRT) via mobile phones and pagers. The alert message included the patient's name, location, and vital signs.

Although this paper did not provide specifications about the e-alert system and how they programmed it, it did describe the key features and functionalities that were included in the system. The e-alert system was designed to automatically identify and alert healthcare providers when a patient met certain sepsis criteria. It also provided alerts for specific interventions that needed to be performed within a specific timeframe, such as administering antibiotics or obtaining blood cultures. Additionally, the system had the ability to send reminders to providers if certain tasks were not completed within the specified timeframe. These features highlight the importance of automation and timely alerts in improving sepsis management and patient outcomes.

2.2 Sepsis response team

According to the paper, the sepsis response team (SRT) consisted of "trained critical care nurses, respiratory therapists, and clinical pharmacists," who were "responsible for rapid recognition and initiation of standardized resuscitation measures for patients with sepsis and septic shock."

The SRT was activated by the electronic alert system, and upon activation, the SRT members would "perform a standardized assessment of the patient, initiate sepsis resuscitation bundle measures, and communicate with the treating team." This shows that having an SRT improves timely antibiotic administration by providing a clear and structured communication pathway for healthcare providers to follow.

2.3 Data Collection

The authors conducted a retrospective analysis of data from a tertiary care hospital in Saudi Arabia. The data for this study were collected from three different phases: the pre-intervention phase, intervention phase 1, and intervention phase 2.

The pre-intervention phase was conducted with data from January 01, 2011–September 24, 2012, and served as the baseline. During this time, diagnosing patients “as having sepsis and initial resuscitation was based on clinical assessment by the ED physicians, the primary admitting service, the intensive care team or a combination of these services.”

Intervention phase 1 was conducted with data from September 25, 2012–March 03, 2013, and the e-alert system was implemented. During this time, an educational campaign was also put in place to teach healthcare professionals about the new e-alert system.

Intervention phase 2 was conducted with data from March 04, 2013, and through October 30, 2013. During this time, the SRT was added to the implementations that had already taken place in the intervention phase 1. A bedside nurse was in charge of activating the SRT after she received an e-alert.

The data was collected using the 2008 SSC data collection tool. It involved a review of electronic medical records and included demographic information, vital signs, laboratory test results, imaging studies, antibiotic administration, fluid resuscitation, and compliance with the sepsis resuscitation bundle.

Results:

The data collected from the electronic medical records were analyzed to evaluate the impact of a multifaceted intervention on sepsis management practices and outcomes. The authors discovered that the implementation of this multifaceted intervention, including an e-alert system and SRT, was associated with significant improvements in compliance with the sepsis resuscitation bundle and reductions in-hospital mortality rates.

Specifically, the study showed that compliance with the sepsis resuscitation bundle increased from 11.8% in the pre-intervention phase to 45.3% in the intervention phase, as can be seen in figure 2. The study also showed that hospital mortality rates among septic patients also decreased from 29.2% in the pre-intervention phase to 23.3% in the intervention phase, as can be seen in figure 3.

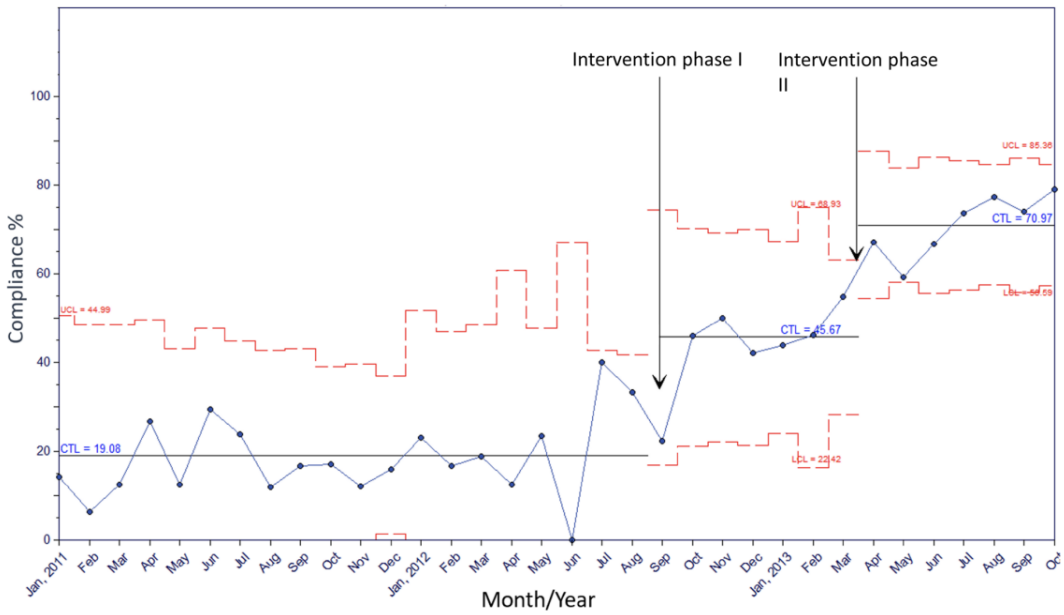

Figure 2: Compliance with Sepsis Resuscitation Bundle

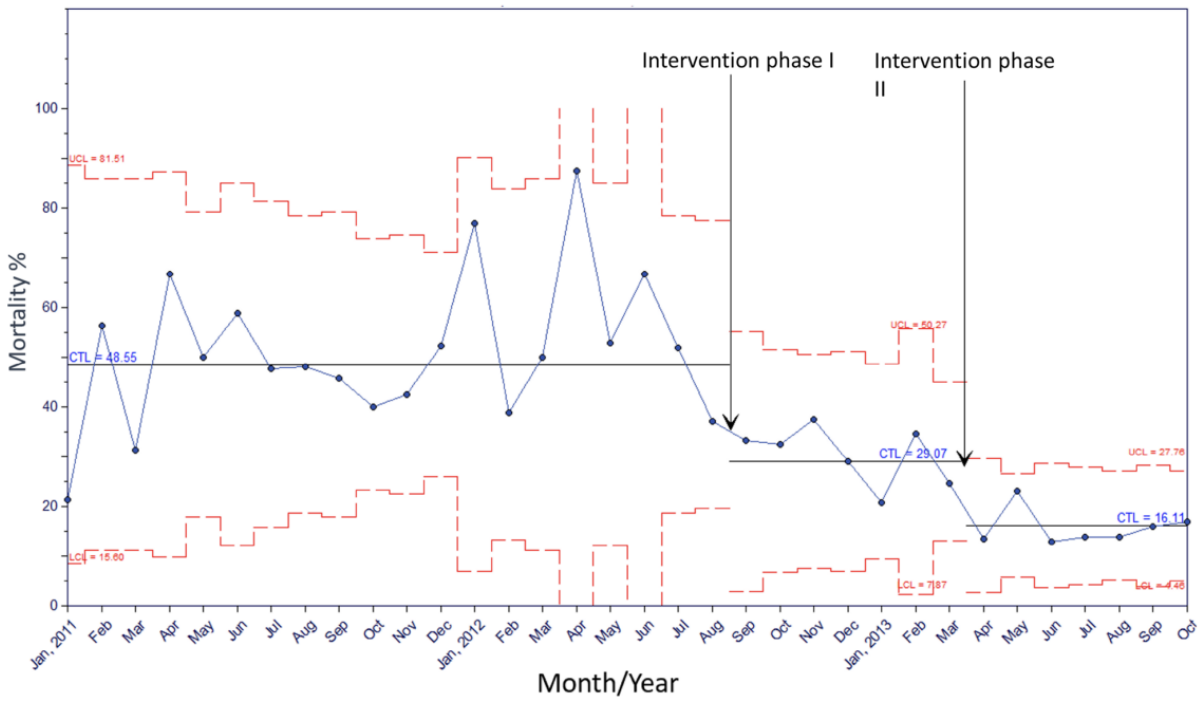

Figure 3: Hospital Mortality Rates

Additionally, the study found that the implementation of the e-alert system was associated with significant reductions in time to antibiotic administration and time to completion of lactate measurement, both of which are important components of the sepsis resuscitation bundle.

Assessment:

The paper presents a well-designed study that aims to investigate the impact of an SRT and an e-alert system on sepsis management and patient outcomes. One of the strengths of the paper is the comprehensive data collection process, which includes both prospective and retrospective data and the use of validated tools for sepsis diagnosis and outcome measures. The paper also clearly outlines the interventions implemented throughout each phase.

However, this paper also has several limitations. To start, the study was conducted in a single hospital. What works well in one hospital may not work in another due to differences in resources, staffing, patient populations, and other factors. Therefore, the findings of this study may not be generalizable to other hospitals or healthcare systems. Additionally, the study does not provide a detailed description of the e-alert system's technical specifications, which limits the replicability of the intervention in other settings. While the authors provide an overview of how the system worked, there is no detailed explanation of the algorithms or programming used to

develop the system. Without the technical specifications, it is difficult for other healthcare facilities to replicate the system and adapt it to their own needs. For example, this paper suggested a great idea for our project but no description of how to implement it. We must now do further research to find a paper that describes the technical specifications.

Relevance and Next Steps:

This paper highlights the importance of interdisciplinary teamwork and communication in the management of sepsis patients. The implementation of an SRT and the use of an e-alert system with real-time communication between team members led to significant improvements in compliance with sepsis bundle measures and patient outcomes.

This paper gave great ideas to improve communication in the management of sepsis patients. One key step is to implement multidisciplinary sepsis teams consisting of physicians, nurses, pharmacists, and other healthcare professionals who work collaboratively to manage sepsis patients. For our project, we will work to use e-alert systems, which allow real-time communication between team members and facilitate timely intervention.

Conclusions:

This paper has shown that the implementation of multifaceted intervention using an e-alert system alongside a sepsis response team demonstrated improvement in antibiotic administration as well as decreased hospital mortality rates and length-of-stays. Overall, this paper provides us with valuable information for our project as it gives a way to alert relevant personnel when it is their turn in the sepsis management process. Previously we had considered using a physical device that sepsis team members would have to wear, and they would be alerted by a buzz. However, we now know an electronic alert system is a viable way to relay information to the SRT. Although it would have been wonderful to know the technical specifications behind the e-alert system implemented, this study is still a valuable contribution to our project as we can now explore an alternative alert system.

References:

1. Arabi, Y. M., Al-dorzi, H., Alamry, A., Hijazi, R., Alsolamy, S., Al Salamah, M., . . . Taher, S. (2017). The impact of a multifaceted intervention including sepsis electronic alert system and sepsis response team on the outcomes of patients with sepsis and septic shock. Annals of Intensive Care, 7(1), 1-10. doi:https://doi.org/10.1186/s13613-017-0280-7