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Surviving Sepsis: A Treatment Process Improvement in High Volume Emergency Departments

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SURVIVING SEPSIS: A TREATMENT PROCESS IMPROVEMENT IN HIGH VOLUME
EMERGENCY DEPARTMENTS

by

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TABLE OF CONTENTS

LIST OF FIGURES	5
ABSTRACT.....	6
PROBLEM.....	7
Statement of the Problem.....	7
Background and Significance	8
ASSESSMENT.....	9
Facility Assessments.....	9
Organization’s Readiness for Change.....	10
Summary of the Evidence from the Literature	10
Critical Appraisal of Evidence.....	11
PROJECT IDENTIFICATION.....	13
Purpose.....	13
Objectives	14
PROJECT METHODS	14
Intervention.....	14
Implementation.....	15
Organizational Barriers and Facilitators	15
RESULTS	16
DISCUSSION.....	18
Limitations	18

Table of Contents—Continued

Sustainability19

Recommendations20

Implications for DNP Essentials and Nursing Practice21

REFERENCES23

APPENDIX: Educational poster/email for the ED and laboratory staff26

LIST OF FIGURES

Figure	Page
1. Sepsis Mortality Percentage Emergency Department #1.....	16
2. Antibiotics Administered <1hr Percentage Emergency Department #1	17
3. Sepsis Mortality Percentage Emergency Department #2	17
4. Antibiotics Administered <1hr Percentage Emergency Department #2	18

Abstract

Sepsis is the third leading cause of death in the United States, accounting for approximately 270,000 deaths annually (Rhee et al., 2017). It is the number one cause of death in hospitals, the number one cause of hospital readmissions, and the costliest diagnosis in the hospital setting (Torio & Andrews, 2015; Torio & Moore, 2016; Fingar & Washington, 2015). This quality improvement project aimed to increase the percentage of antibiotics administered within 1 hour for sepsis patients. Mortality rates significantly decrease when this goal is met (Howell & Davis, 2017). There is an 8% increase in mortality risks with every hour that passes with elevated lactic acid and white blood cell counts without treatment (Kumar et al., 2006). Nearly 80% of deaths related to sepsis could be prevented with rapid treatment (Kumar et al., 2006). There was a significant lag in laboratory specimen processing time at two San Antonio, Texas, emergency departments. Everything was ordered stat, rendering nothing stat. This was delaying life-saving treatment for sepsis patients. An ultra-stat method was introduced that encompassed the utilization of a yellow biohazard bag to transport sepsis serum specimens to the laboratory indicating ultra-stat priority processing. This was aimed at improving the result time of laboratory specimens screened as sepsis. The goal was to improve antibiotic administration time for emergency department sepsis patients at these two facilities. Mortality rates and antibiotic delivery times pre- and post-intervention were collected. The results were that: ultra-stat yellow biohazard bag utilization increased antibiotic administration under 1 hour rates and decreased sepsis related mortality.

Keywords: emergency department, mortality, sepsis, ultra-stat

Problem

Sepsis is characterized by multi-organ dysfunction and/or failure as a result of an uncontrolled infection (World Health Organization, 2018). When left untreated, sepsis often rapidly leads to death (World Health Organization, 2018). The emergency department is the entryway to the hospital. This is where the majority of patients come when feeling symptoms of sepsis. Prompt assessment and treatment in the emergency department by prescribing providers is a valuable asset in decreasing risks of mortality (Lewis et al., 2018). Upon assessment of two high volume emergency departments in San Antonio, Texas, there was a significant lag in critical laboratory value result times, specifically the lactate (lactic acid) and white blood cell count. This resulted in significant delays in life-saving treatment at these facilities.

Statement of the Problem

Approximately 1.7 million adults in the United States develop sepsis annually (Rhee et al., 2017). Of those, roughly 270,000 will die as a result (Rhee et al., 2017). Roughly 50% of intensive care unit (ICU) admissions are due to sepsis (Cawcutt & Peters, 2017). Of the patients who die in the hospital, one in three die due to sepsis (Rhee et al., 2017). Established goals in both facilities are to initiate intravenous antibiotic therapy within 1 hour for greater than 65% of sepsis patients and reduce the sepsis related mortality rate to less than 8%. When these standards are met by emergency room providers, sepsis related mortality decreases significantly. Pre-intervention (February 2018 – May 2018) average antibiotic administration in less than 1 hour for Emergency Department #1 was approximately 46% and Emergency Department #2 was 48%. Pre-intervention (February 2018 – May 2018) sepsis related mortality rates in Emergency Department #1 was approximately 33% and Emergency Department #2 were 26%. According to

the most recent research, in order to decrease sepsis related mortality rates, there must be improvement in the timing of antibiotic initiation (Rhodes et al., 2017).

Background and Significance

There is a Surviving Sepsis Campaign (SSC) focused on decreasing sepsis related mortality by promoting best practices. SSC does this in many ways but most importantly, it gathers current sepsis related research and translates it into understandable protocols. SSC has step-by-step guidance available for implementing the newest evidence-based practices. SSC has educational posters available to assist with educating those caring for the sepsis patient. All things sepsis can be found on the SSC website and are free to view, download, and print (Surviving Sepsis Campaign, 2018). Both facilities in this process improvement project utilized these resources.

The Journal of American Medical Association sets the standard of care for sepsis. The first goal outlined by the Journal of American Medical Association is to have antibiotics administered within 1 hour of sepsis recognition (Howell & Davis, 2017). The Journal of American Medical Association recommends fluid resuscitation within 3 hours of sepsis recognition (Howell & Davis, 2017). If vasopressors are initiated (norepinephrine is first choice), the Journal of American Medical Association recommends maintaining a mean arterial pressure greater than 65mmHg (Howell & Davis, 2017). The same standards exist at these emergency departments.

The most effective way of analyzing the problem subjectively is to follow real sepsis cases in real time. At each facility a sepsis alert is initiated when the patient is triaged by the registered nurse and the patient meets standardized sepsis criteria outlined on the sepsis protocol

worksheet. Any of the following two criteria indicate a suspected sepsis patient and all three indicate a positive sepsis during triage:

- Heart rate equal to or greater than 90 beats per minute.
- Respiratory rate equal to or greater than 20 breaths per minute.
- Temperature equal to or greater than 100.4°F.

Patients meeting suspected or positive sepsis criteria are moved into a holding room where the intravenous access is initiated, laboratory specimens are collected, and sent to the laboratory ordered STAT. Initial fluid bolus is administered per provider assessment and orders. Antibiotics are ordered after laboratory results reveal a lactic acid equal to or greater than 2mmol/L and/or white blood cell count equal to or greater than $12 \times 10^9/L$. Some of the common antibiotics used at these emergency departments include: Piperacillin/Tazobactam, Meropenem, Ceftriaxone, Levofloxacin, Ampicillin/sulbactam, Cefotaxime, and Ceftazidime.

Assessment

Facility Assessment

Emergency department #1 was located in an urban setting. Approximately 150 patients are seen in a 24-hour period. Emergency department #2 was located in a suburban setting. Approximately 135 patients are seen in a 24-hour period. Both emergency departments were level four trauma centers with sepsis as the third most common diagnosis. Staffing each facility was complex, with variations in staff scheduling, staff members were continuously coming and going. There was also a high employee turnover rate. This left it difficult to determine an exact number of staff at any given time. There were approximately 10 medical doctors, 14 nurse practitioners and physician assistants, 52 nurses, and 13 medical technicians who staff each facility.

Organization's Readiness for Change

At both facilities, as many as eight participants from varying disciplines met monthly as a team to discuss sepsis related issues. Members included two emergency department registered nurses, an emergency department medical assistant, the emergency department nursing director, the emergency department medical director, the pharmacy director, the laboratory director, and the sepsis coordinator. Team members discussed recent sepsis trends within the emergency department and nationwide, new strategies for process improvement, and outlook of future implementation strategies. There was no Doctor of Nursing Practice Advanced Practice Registered Nurse (DNP, APRN) on the sepsis team. An argument could be made to include one in these types of meetings because the DNP prepared APRN brings a different set of skills compared to their medical doctor (MD) counterparts. The DNP, APRN has the ability to translate research into practice with the forethought on how it will holistically affect the nursing staff, ancillary staff, and the patient.

Key stakeholders for this project include the medical director of the emergency department, emergency department providers, emergency department nursing staff, sepsis coordinators, and laboratory director. Securing participation from said stakeholders was crucial for successful implementation of this sepsis process improvement project. During the facility assessment, readiness for change was enthusiastically expressed by all stakeholders at both facilities. All key stakeholders were vested in implementing best practices to ensure compliance with all sepsis metrics, in hopes of improving patient centered outcomes.

Summary of the Evidence From the Literature

It was the goal of this project to utilize the strongest and most recent evidence available to aid in supporting theories presented. In addition to strong evidence, there was a need to utilize

the most reliable, up to date protocols related specifically to sepsis. Prolonged elevated lactic acid and white blood cell count levels have shown strong correlations to increased mortality (Fan, Miller, Lee, & Remick, 2016). In support of this project, literature suggests rapid sepsis identification and treatment are crucial to decrease sepsis related mortality rates (Rhodes et al., 2017). Specifically, when the patient presenting with sepsis is treated with antibiotics within 1 hour of arrival, this will significantly decrease mortality risks by as much as 15% (Lester, Hartjes, & Bennett, 2018; Howell & Davis, 2017).

Unfortunately, not all professionals agree with these standards set for sepsis treatment. Objectors say the 1 hour compliance standard can decrease quality of care of other emergent patients in the emergency department (Pallin & Spiegel, 2018). Additionally, they believe tailor made medicine serves a purpose but not in an emergency acute setting (Pallin & Spiegel, 2018). They also believe, the aggressive treatment of patients with sepsis symptoms can be harmful to patients with comorbidities (Pallin & Spiegel, 2018). Although they do agree with aggressive treatment for the truly septic patient, they disagree these standards will actually decrease overall mortality (Pallin & Spiegel, 2018).

Critical Appraisal of Evidence

As previously mentioned, there is ample up-to-date research on sepsis. Thus, we narrowed our critical evidence appraisal focusing on the sepsis patient in the emergency department. Sepsis is the third most common diagnosis in both emergency departments. With such a common diagnosis, it is important to be up to date with best practices and be innovative in ways to further improve best practices tailored to the facility. Delayed laboratory value processing time, as previously mentioned, was an issue identified in both facilities in this project. Many studies suggest there is a significant decrease in mortality when the antibiotics are

administered according to the SSC recommendations (De Backer & Dorman, 2017; Howell & Davis, 2017; Rhodes et al., 2017). An observational study on over 150 patients diagnosed with sepsis compared hypotensive versus non-hypotensive patients with sepsis in the emergency department (Ballester et al., 2018). The authors found no difference in mortality rates between patients presenting with hypotension and those that were normotensive on initial presentation. However, they did find a delay in antibiotic administration resulted in increased mortality rates (Ballester et al., 2018). A retrospective analysis screened 294 patients diagnosed with sepsis in one emergency department and found a 3% increase in odds of mortality for every hour of delayed antibiotics (Hirschy, Sterk, Dobersztyn, & Rech, 2018). Lewis et al. (2018) hypothesized with every hour delayed in first antibiotic administration there is a direct correlation with physical deterioration and an increase in mortality risks. In an experiment on 200 mice, a progressively shortened survival correlated with every hour delay in antibiotic administration (Lewis et al., 2018).

Understanding laboratory values is a crucial skill when treating sepsis patients. In a prospective analysis of over 500 patients' laboratory specimens comparing lactate (lactic acid), white blood cell count, and procalcitonin; lactate was shown to be the best biomarker for sepsis identification (Karon et al., 2017). A retrospective review on over 2,100 patients diagnosed with sepsis, looked at lactate measures and antibiotic administration time correlation with mortality (Han et al., 2018). The authors found that with a sustained serum lactate level and/or delayed antibiotic administration times there is an increase in mortality of approximately 29% (Han et al., 2018). A similar retrospective analysis evaluating lactate laboratory specimen processing times in 2,144 patients diagnosed with sepsis had similar results (Han et al., 2018). A retrospective analysis of 1,278 sepsis patients with increased lactate (lactic acid) levels demonstrated an

increase in mortality rates. Lactate 0-2.4 = mortality rate of 4.9%, lactates 2.5-3.9 = mortality rates of 9%, & lactates greater than 4.0 = 28.4% (Fan et al., 2016).

As lactate levels increase, mortality risk also increases. With rapid antibiotic administration, mortality rates decrease. Making rapid antibiotic administration a priority intervention decreases mortality risks in patients.

Project Identification

Purpose

The purpose set forth by this project was to decrease laboratory specimen processing time in septic patients, thus leading to an expedited antibiotic prescribing time by the provider. This project utilized the six aims of the Institute of Medicines to purposefully determine and carry out the project intervention (Agency for Healthcare Research and Quality, 2016).

- Safety is accomplished by avoiding harm to the patient during sepsis screening and medical intervention. Assessing allergies before antibiotic administration and maintaining hemodynamic stability will accomplish this.
- Effectiveness of care refers to recognizing the signs and symptoms of sepsis and promptly calling the sepsis alert.
- Patient-centered respects the patient's preferences, needs, values, and concerns.
- Timeliness of care was aimed at reducing wait times and delays in patient care that may lead to harmful consequences.
- Efficiency was aimed at avoiding wasted time, supplies, equipment, and energy.
- Equitable care was to provide quality care regardless of gender, ethnicity, or socioeconomic status (Agency for Healthcare Research and Quality, 2016).

Objectives

There were two main objectives in this quality improvement project. 1. Decrease sepsis related mortality. 2. Improve antibiotic administration times to be within 1 hour for patients assigned a sepsis diagnosis. The goals of each facility, as previously mentioned, were administering antibiotics in less than 1 hour greater than 65% of the time and keeping sepsis related mortality less than 8%. Neither one of the facilities were meeting these metrics. Pre-intervention (February 2018 – May 2018) average antibiotic administration in less than 1 hour times for Emergency Department #1 were approximately 46% and Emergency Department #2 were 48%. Pre-intervention (February 2018 – May 2018) sepsis related mortality rates for Emergency Department #1 were approximately 33% and Emergency Department #2 were 26%. Additionally, it was the intent of this project to increase staff confidence and motivation in improving the treatment of sepsis patients.

Project Methods

Intervention

For both facilities, the critical laboratory value reporting times adversely affected antibiotic delivery times. The goal of this project was to improve sepsis patient laboratory value resulting times by utilizing an ultra-stat laboratory process intervention. Discussions during monthly sepsis meetings with the medical director and laboratory director resulted in the implementation of a yellow laboratory biohazard bag warranting priority processing by the laboratory staff. Clear biohazard bags were used to send specimens through a tube system from the emergency department to the laboratory. An intervention to change the color of some bags for sepsis-only serum specimens was a viable solution bearing no cost alteration to the

institution. The cost of the yellow biohazard bags is equal to the clear ones. The yellow biohazard bags were easy to order.

This quality improvement project does not meet federal regulatory requirements for human subject research. It was deemed to not require institutional review board approval from the University of the Incarnate Word. Refer to reference number NRR – 19032 for details from the institutional review board determination of this Doctor of Nursing Practice quality improvement project.

Implementation

It took an interdisciplinary approach to implement the yellow biohazard bag intervention. Education for both the emergency department and laboratory staff notifying them of the process change was completed during staff meetings, emails, and posters around the laboratory and emergency department (see Appendix). Intervention began February 2019. When patients screened positive for sepsis during their initial medical screening exam, the serum specimens were sent to the laboratory utilizing yellow biohazard bags instead of clear biohazard bags. The yellow biohazard bags were kept in place in the same location as the clear ones to facilitate their accessibility. After a yellow biohazard bag arrived to the laboratory, the technicians acknowledged the sepsis-only specimen, requiring them to prioritize its processing. The yellow biohazard bags are still being used today.

Organizational Barriers and Facilitators

Few barriers were met during the implementation of this project. The initial navigation of the facility, key-stakeholder identification, and yellow biohazard bag procurement required a lot of time and effort. However, once key stakeholders vetted the project, the implementation ran smoothly. Key stakeholders expressed willingness to promote this project because of the possible

improvements in sepsis mortality rates. The adoption of a yellow biohazard bag did not incur additional resources from anyone making it a sustainable intervention.

Results

Evaluation of the emergency department process change was done by gathering data pre and post intervention. Measurements of intervention effectiveness was gathered by using the data metrics sepsis quest dashboard. Data auto-populates from the electronic medical record into the sepsis quest dashboard. The sepsis coordinators analyze the data and disseminate it to the staff, identified above, during monthly sepsis meetings. Determination of success was based on improved antibiotic administration times and a decrease in sepsis mortality.

The yellow biohazard bag process improvement project ran from February 2019 to May 2019. We analyzed this year's data to last year's data during the same months to account for comparable seasonal diagnoses. Pre-intervention data was collected from February 2018 to May 2018. Post-intervention data was collected from February 2019 to May 2019. Post-project data demonstrated both emergency departments had an overall decrease in sepsis related mortality and improved antibiotic administration times. Emergency department #1 had an average decrease of 12% in mortality rates and an average increase of 23% in antibiotic administration time under 1 hour. See Figures 1 & 2.

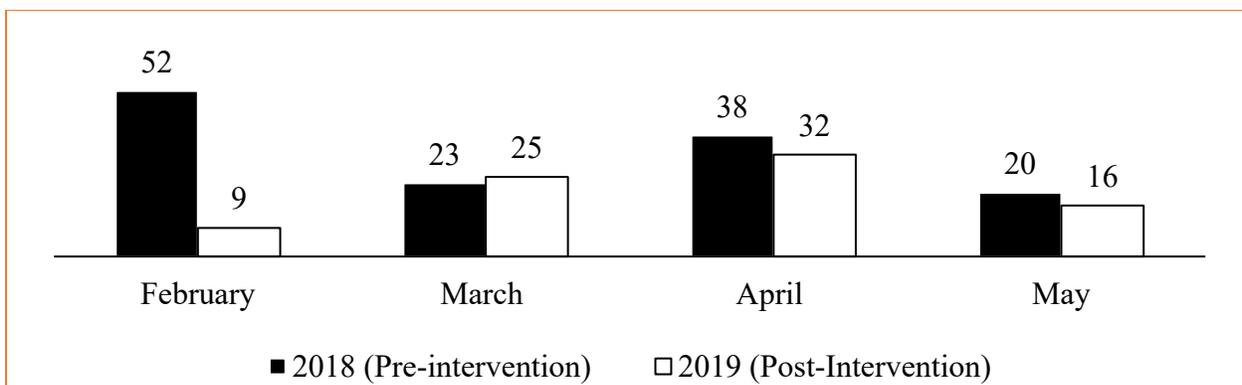


Figure 1. Sepsis mortality percentage for emergency department #1. Percentage of all patients diagnosed with sepsis leading to mortality in each month. Four-month average of 33% in 2018 and 21% in 2019.

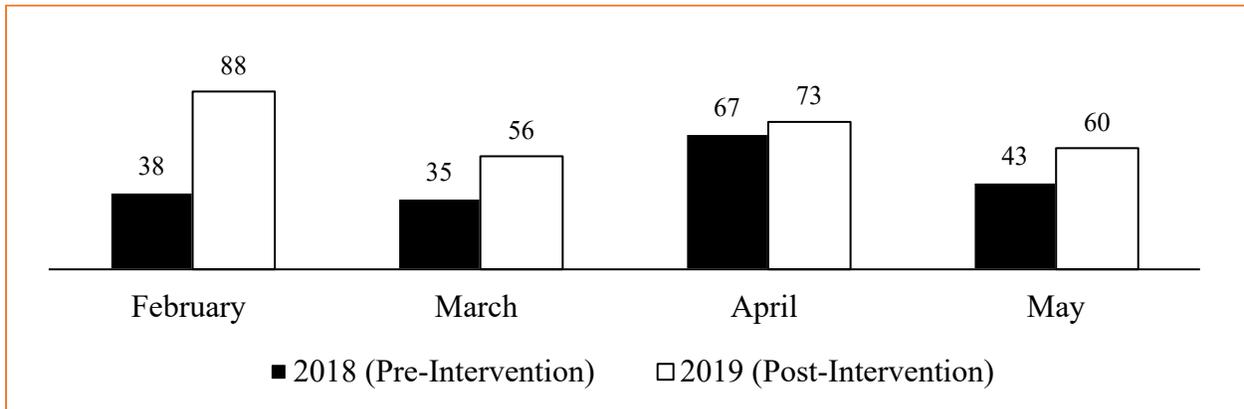


Figure 2. Antibiotic administration time <1hr % for emergency department #1. Percentage of patients diagnosed with sepsis who received antibiotics in under 1 hour. Four-month average of 46% in 2018 and 69% in 2019.

Emergency department #2 had an average decrease of 4% in mortality rate and an average increase of 38% in antibiotic administration time, within the 1 hour. See Figures 3 & 4.

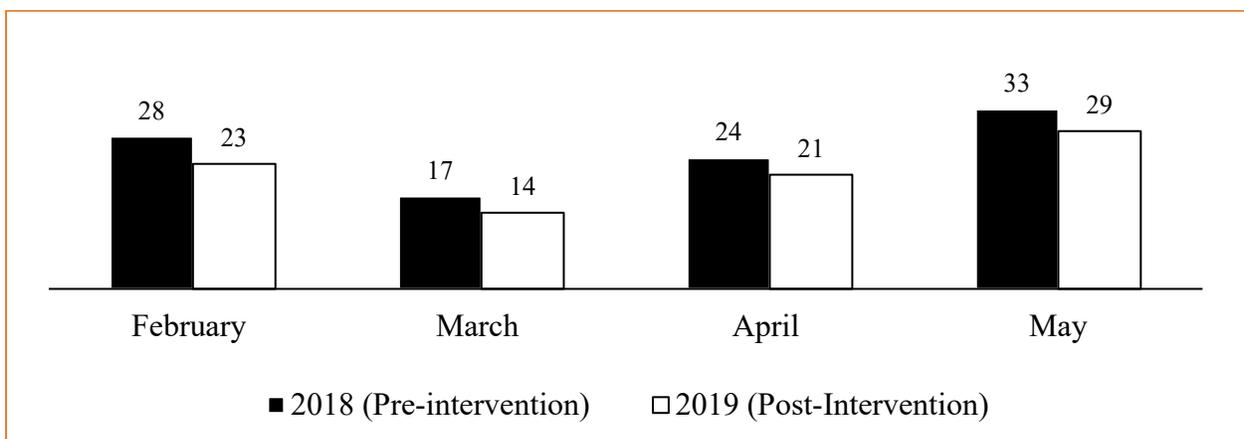


Figure 3. Sepsis mortality percentage for emergency department #2. Percentage of all patients diagnosed with sepsis leading to mortality in each month. Four-month average of 26% in 2018 and 22% in 2019.

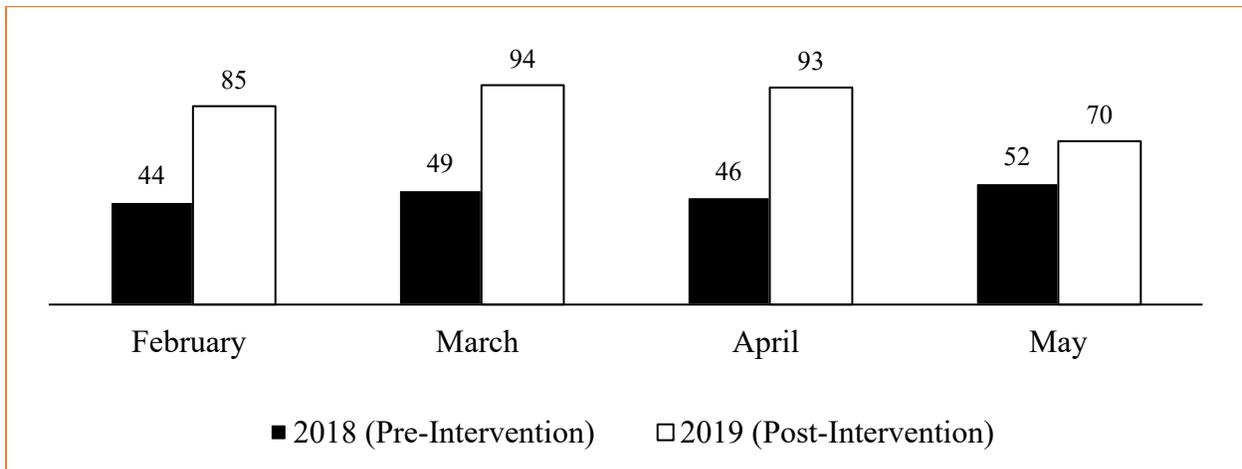


Figure 4 Antibiotic administration time <1hr % for emergency department #2. Percentage of patients diagnosed with sepsis who received antibiotics in under 1 hour. Four-month average of 48% in 2018 and 86% in 2019.

Positive results were seen post intervention. The goal of less than 8% overall mortality was not met in any month in either facility, but significant improvements were seen. Antibiotic given under 1 hour goal of greater than 65% was achieved in all months in emergency department #2 and achieved in 2 of the 4 months in emergency department #1.

Discussion

Limitations

High employee turnover is a widespread issue in the emergency department setting. These emergency departments were no exception. With a high employee turnover, new employees needed reinforcement on the novel yellow biohazard bag process. These emergency departments had great team a positive work atmosphere. The seasoned employees happily educated new employees on the yellow biohazard bag process. However, even with heavy

employee involvement, the yellow biohazard bag got lost in the shuffle amongst those unfamiliar with its usage.

Another issue in any emergency department setting is the is a large volume of patients. It is easy for the staff to get overwhelmed during a patient surge window resulting in a higher noncompliance rate. Also, it was found that during the delegation of tasks, the yellow biohazard bag was not always being used. Lastly, nurse staff members educated on the yellow bag intervention tended to forget to notify the subordinate technicians on the need to place the designated specimens in the yellow bag.

Misuse of the yellow biohazard bag was not a common finding, but it did occur. The yellow biohazard bag was used on a few occasions for specimens not belonging to sepsis patients. One reason behind this was lack of training in proper use of the yellow biohazard bag. Also, when clear biohazard bags were not readily available, they would simply use a yellow biohazard bag instead. This may have negatively affected the results of this project intervention.

There was no direct measure of the percentage of yellow biohazard bags used versus not used. It would have been a cumbersome task, taking focus away from the true intent of this process improvement project, which was to decrease mortality by increasing antibiotic administration times in accordance to the evidence. Indirect measures of project intervention outcomes were enough to encourage future process improvement projects to focus in this area. It is important to minimize these limitations when possible. The following will discuss possible solutions to ensure sustainability and minimize limitations.

Sustainability

Investment from key stakeholders is of utmost importance for sustainability of an intervention. This was achieved at both facilities for the project. The emergency department

medical directors, emergency department staff, sepsis coordinators, laboratory directors, and laboratory staff bought into the yellow biohazard bag intervention. Everyone was encouraged and invigorated by the positive results yielded by the relatively simple process change.

When a patient was diagnosed with, or suspected to have sepsis, the staff utilizes the sepsis worksheet to guide them through the proper steps of the sepsis work-up. The worksheet now includes the yellow biohazard bag utilization to transport specimens to the laboratory. This alone will aid in the progression and sustainability of this process improvement.

Simple, well thought out interventions save lives. The knowledge of this project's positive results and the desire to save lives is what will drive the sustainability of this quality improvement project.

Recommendations

The methodology of this project decreases sepsis related mortality and improves life-saving antibiotic administration time to under 1 hour. The low financial footprint, nominal process alteration, and excellent results make this quality improvement project suitable for implementation in other emergency departments. It's important to emphasize the "everything stat = nothing stat" culture is affecting our ability to provide efficient patient care. Processes need to be re-evaluated periodically to ensure sound methodology.

Laboratory department quality assurance activities are also needed. At the conclusion of this project, the laboratory director at one of the facilities implemented a process for the laboratory technicians to measure how often the yellow biohazard bag is utilized and who it is used for (sepsis versus non-sepsis). It is the hope of the laboratory director to help improve patient outcome measures by encouraging the use of the yellow biohazard bag for the entire hospital, not just the emergency department.

Implications for DNP Essentials and Nursing Practice

The following eight Doctorate of Nursing Practice essentials apply to this quality improvement project:

- Scientific Underpinnings for Practice
 - Utilized the most recent up to date research from SSC & the Journal of American Medical Association.
- Organizational and Systems Leadership for Quality Improvement
 - Implementation of patient centered quality improvement intervention and evaluated outcomes.
- Clinical Scholarship and Analytical Methods for Evidence-Base Practice
 - Created unique solution to a complex problem.
- Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care
 - Utilized available technologies to evaluate patient centered outcomes.
- Health Care Policy for Advocacy in Health Care
 - Implementation of a safe patient intervention according to facility health care policies.
- Inter-Professional Collaboration for Improving Patient and Population Health Outcomes
 - Multidisciplinary collaboration to improve sepsis related mortality.
- Clinical Prevention and Population Health for Improving the Nation's Health
 - Intervention is easily replicate-able for facilities with similar problems.
- Advanced Nursing Practice

- Conducted needs assessment. Mentored emergency department providers, nurses, medical technicians, laboratory staff, etc.

(American College of Nursing, 2006)

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Appendix: Educational poster/email for the ED and laboratory staff

SURVIVING SEPSIS

A SIMPLE PROCESS IMPROVEMENT TO SAVE LIVES



USE THIS BIOHAZARD BAG FOR PATIENT LAB SPECIMENS MEETING SEPSIS CRITERIA. THIS IS AN INDICATION TO THE LABORATORY THAT THIS REQUIRES PRIORITY PROCESSING!!!

BEGIN NEW PROCESS NOW!!!!
GOING LIVE WITH DATA COLLECTION STARTING
FEBRUARY 1