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Moving Evidence into Practice: Early Sepsis Identification and Timely Intervention in the Emergency Department (Project Code Sepsis)

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This is to certify that the doctoral study by

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MS, California State University, Los Angeles, 2010

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Project Submitted in Partial Fulfillment

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Abstract

Sepsis is the leading cause of death among hospitalized patients in the United States, is responsible for more than 200,000 deaths annually, and has as high as a 50% mortality rate. Sepsis requires prompt identification so that early goal-directed therapy can be instituted to lead to better outcomes. The purpose of this quality improvement project was to determine if implementing an evidence-based identification and intervention program, *Project Code Sepsis*, in the emergency department can increase the number of patients who receive antibiotics within the first hour of triage and decrease the length of hospital stay. Specifically, the primary project goals were: (a) to administer initial antibiotic treatments within 1 hour of triage to more than 75% of patients, and (b) to reduce length of hospital stay to an average of less than 7 days. The project was developed from the Donabedian Healthcare Quality Triad and guided by the Six Sigma DMAIC method. A total of 306 patients were included in this project conducted from May to October 2015. The sepsis-screening tool was fully implemented during August when more than 75% of patients received their initial antibiotic within one hour of triage time. However, this accomplishment was not sustained during the next two months. Interestingly, August was also the month with the highest length of hospital stay (7.49 days) among sepsis patients. This quality improvement project did not show that the provision of antibiotic therapy within the first hour of triage time decreases the length of hospital stay among sepsis patients. Multiple factors including administration of intravenous fluids and vasopressors for hypotension, nurse and physician experiences, patient acuity, and local sepsis bacteria profile should be considered together in future studies and quality improvement projects.

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Section 1: Overview of the Evidence-Based Project

Introduction

Improving the quality of care is a continuous process for health care organizations. Historically accepted clinical practices, including experienced-based practices, are no longer acceptable. Contemporary health services need to be evidence-based, incorporating research findings into clinical practice. Evidence-based practices not only benefit patients, but organizational efficiency is also improved and lower costs for care are achieved. This Doctor of Nursing Practice (DNP) project, called *Project Code Sepsis*, incorporates an evidence-based approach to achieving early sepsis identification and evidence-based interventions in the emergency department (ED). Early sepsis identification leads to timely treatment that reduces morbidity and mortality, decreases intensive care unit (ICU) days, and decreases the cost of care (Kleinpell & Schorr, 2014).

Problem Statement

With more than 750,000 new sepsis diagnoses (Yealy et al., 2014) and more than 200,000 deaths annually (Faro, 2014), this systemic infection is the leading cause of death in hospitalized patients in the United States (Lopez-Bushnell, Demaray, & Jaco, 2014). Sepsis is defined as "a systemic inflammatory response initiated by a source of infection" transported throughout the body via the circulatory system (Kleinpell, Aitken, & Schorr, 2013, p. 213). This life-threatening condition progresses from a localized to a severe systemic infection, resulting in prolonged hypoperfusion and subsequent organ dysfunction. Untreated, sepsis rapidly progresses to septic shock with multi-organ failure due to persistent hypotension despite fluid resuscitation (McClelland & Moxon, 2014).

Importantly, fluid resuscitation to reverse the volume-based hypotension is only effective when delivered early in the evolution of sepsis.

Despite evidence-based treatment modalities for sepsis management, mortality rates for severe sepsis and septic shock are reported to be as high as 50%, while the incidence is increasing 1.5% annually (Schub & Schub, 2013). Inadequate early sepsis identification is the primary barrier to effective interventions to prevent septic shock (McClelland & Moxon, 2014). With early sepsis identification and timely evidence-based interventions, the mortality rate is decreased between 16% and 28% (El Solh, Akinnusi, Alsawalha, & Pineda, 2008; Nguyen, Schiavoni, Scott, & Tanios, 2012; Rivers et al., 2011).

The project hospital has a high mortality rate because of inconsistent and late sepsis identification resulting in delayed interventions. For example, from 2012-2013, the project hospital's sepsis mortality rates were higher than the 15% goal set by the California Health and Human Services Agency (2012). In addition, the organization is below the goal of a greater than 50% success rate for initiating antibiotic therapy within one hour of a patient's arrival to ED (see Appendix A). Furthermore, there are multiple issues regarding sepsis identification in the ED, including those patients not diagnosed with sepsis but who meet the systemic inflammatory response syndrome (SIRS) criteria for diagnosis (see Appendix B). Finally, the organization's patient length of hospital stay for sepsis is high, within the top 10% of all hospitals in the nation (see Appendix C).

Purpose Statement and Project Objectives

Health care organizations continuously improve clinical practices, seeking to develop more efficient and reliable processes that result in better patient outcomes and profitability. Reimbursements for health services are increasingly linked to quality indicators (Medicare, n.d.). According to internal data, the project hospital estimates 80% to 90% of the septic patients requiring hospitalization present through the ED. As such, the ED is the critical point to implement an evidence-based approach for early sepsis identification and timely intervention essential to reduce morbidity and mortality.

The purpose of this project was to determine if implementing an evidence-based early identification and intervention program, *Project Code Sepsis*, in the ED would result in more patients with sepsis receiving antibiotics within the first hour of triage. Secondarily, the project examined if there was an impact on the overall length of hospital stay. More specifically, the two primary project goals included: (a) administering initial antibiotic treatments within one hour of triage time to more than 75% of patients, and (b) reducing patient length of hospital stay to an average of less than seven days.

Project Code Sepsis is a program implemented in the ED to achieve early identification of patients with sepsis using an evidence-based screening tool, adapted from the Centers for Medicare and Medicaid Services (CMS; QualityNet, n.d.). The screening tool is composed of several elements including screenings for: (a) systemic inflammatory response syndrome (SIRS) criteria, (b) evidences of organ dysfunction, and (c) potential source of infection (see Appendix D).

In the rapid sepsis screening process, the following steps were implemented: (a) upon the patient's arrival, the triage nurse assesses patient eligibility to participate in the study (based on inclusion criteria); (b) if eligible, the triage nurse screens the patient to determine signs and symptoms of sepsis; (c) if the initial screening is negative, the assessment tool is passed to the emergency nurse assigned to the patient (to continuously screen the patient until admitted to the floor, transferred to another hospital, or discharged); and (d) if the initial screening is positive, the attending physician is promptly informed and the evidence-based intervention initiated.

The early goal-directed therapy (EGDT) was developed from the Surviving Sepsis Campaign (SSC) guidelines endorsed by the Institute for Healthcare Improvement (2015a). The guidelines include multiple interventions, referred to as a bundle, demonstrated to be effective in patient care. This project focused on the initial screening and the first intervention, antibiotic administration in the ED. For the list of antibiotics used for suspected or actual sepsis, see Appendix E.

Significance to Practice

Sepsis is a global health problem associated with mortality rates of 10% to 50% (Schub & Schub, 2013). Nurses are at the fore-front of implementing evidence-based practices to promote better outcomes (Kleinpell & Schorr, 2014). ED patient sepsis screening, beginning with the triage nurse and followed by primary ED nurse and attending physician, is a performance improvement process focused on early identification and EGDT. The benefit of routine sepsis screening is the defined pathway for EGDT (Kleinpell et al., 2013).

The principle goal-directed therapy impacting patient outcomes is the delivery of the appropriate antibiotic within one hour of sepsis identification. Although the Institute for Healthcare Improvement (2015a) recommends administering a broad-spectrum antibiotic within three hours of sepsis identification, the best clinical outcome is achieved when antibiotics are delivered within the first hour. The survival rate is reported to decrease by 8% for each hour therapy is delayed (Gauer, 2013). Delivering the antibiotic within one hour thus increases the survival rate by 16%. In addition, a patient hospitalized secondary to sepsis, is eight times more likely to die and 50% less likely to be discharged home when compared to patients with a different diagnosis (Tazbir, 2012). Recognizing sepsis early, before progression to severe sepsis and septic shock, results in better outcomes (Miller, 2014). A nurse-driven quality improvement project targeting early sepsis identification and timely intervention with an antibiotic is a potential solution to a serious patient condition.

Project Questions

This DNP project focused on initiating an intervention in the ED and explored the following question: What impact will the implementation of *Project Code Sepsis* have on two quality measurements: (a) time to first antibiotic administration, and (b) length of hospital stay in the population of 30- to 85-year-old patients admitted through the emergency department?

Evidence-Based Significance of the Project

To reduce preventable morbidity and mortality related to sepsis, the United States Society of Critical Care Medicine and The European Society of Intensive Care Medicine

created the SSC to provide evidence-based practice guidelines to identify and manage sepsis in acute-care hospitals (SSC, n.d.). The SSC developed an evidence-based care bundle to clearly guide clinicians in the identification and management of sepsis. A care bundle is a set of interventions that when used together improve patient outcomes (McClelland & Moxon, 2014).

The sepsis bundle is composed of the three-hour resuscitation and the six-hour septic shock bundles (Lopez-Bushnell et al., 2014). Included in the three-hour resuscitation bundle is the timely administration of antibiotic therapy. According to expert consensus (Gauer, 2013) and research (Kumar et al., 2006), antibiotic therapy should be provided within the first hour of diagnosis. Surveys of hospitals that instituted EGDT programs showed a 45% relative-risk reduction in their mortality rates for sepsis (Gauer, 2013).

Implications for Social Change in Practice

Health care impacts each person at some point in life. People enter the hospital to get better when sick, and at times to alleviate pain and suffering. Continuously enhancing care delivery is necessary to provide better service and to promote better outcomes. Nursing knowledge can be used to implement guidelines and protocols that are based on available evidence or consensus statements and expert recommendations. Nurses are proactive clinicians responsible for caring for patients and participating in curative and palliative processes. Care based on the latest scientific evidence should mirror our everyday practices to provide the maximum benefit for patients. For this project, nurses were asked to help improve patient care by conducting early screening for signs and

symptoms of sepsis purposed to provide early antibiotic therapy. Nurses are the frontline clinicians responsible for positively impacting patient care through evidence-based practices (Institute of Medicine, 2004).

Definition of Terms

There were four operative terms in the project. Below, I provide definitions of these terms and provide the criteria for determining the presence of varying severity levels for sepsis.

Sepsis: "A systemic inflammatory response initiated by a source of infection" and spread via the circulatory system (Kleinpell, Aitken, & Schorr, 2013, p. 213).

Severe sepsis: Organ dysfunction or evidence of hypoperfusion resulting from sepsis infection (McClelland & Moxon, 2014).

Septic shock: The persistent hypotension with mean arterial pressure less than 65 that, despite fluid resuscitation, can lead to multi-organ failure (McClelland & Moxon, 2014).

Systemic inflammatory response syndrome: A severe inflammatory reaction manifested by multiple signs as a reaction to a variety of illnesses or injuries (McClelland & Moxon, 2014).

SIRS is present when two or more of the following criteria are met: (a) fever or hypothermia, (b) tachycardia, (c) tachypnea, and (d) leukocytosis or leukopenia (Gauer, 2013). For this project, SIRS criteria was based on the sepsis core measure elements released by the CMS for inpatient hospitals and included the following parameters: (a) temperature of greater than 100.9 degrees Fahrenheit or less than 96.8 degrees

Fahrenheit, (b) heart rate of more than 90 beats per minute, (c) respiratory rate of more than 20 per minute, and (d) white blood cell count of more than 12,000 per cubic millimeters or less than 4,000 per cubic millimeters or more than 10% bands (QualityNet, n.d.).

Assumptions and Limitations

This DNP project used a nurse-driven protocol to increase the early identification of sepsis in patients presenting to the ED, and to provide timely administration of antibiotic therapy. This project had four limitations. First, the project location was in the ED of one hospital. Thus, generalizability is an issue since the study population may not represent the general population. Second, the sample size is relatively small, preventing robust statistical analysis pre- and post-intervention. However, this was a quality improvement project and not a research study, and was developed to implement evidence-based knowledge into nursing practice. Third, one of the elements in the sepsis-screening tool (urine output), was not helpful in promoting the administration of antibiotic therapy within one hour of triage time since it can only be met if the urine output is less than 0.5 milliliters (ml) per kilogram (kg) per hour (hr) for two hours. And finally, health care practitioners were aware that they were part of a project, which may have affected their performances. Knowing their work was monitored as part of a quality improvement project may have unconsciously made them perform better compared to their routine work.

Summary

This section presented a brief overview of sepsis, the patient impact, and the cost to society. Evidence shows that rapid sepsis identification leads to the early initiation of therapies that result in reduced morbidity, mortality, and cost. Nurses are on the frontline of patient care, and in collaboration with other disciplines are capable of implementing evidence-based practices that impact patient and organization outcomes. The next section presents the current scholarly evidence related to sepsis.

Section 2: Review of Scholarly Evidence

Introduction

Sepsis is a progressive complication stemming from an infection which spreads through the circulatory system and manifests as a serious systemic inflammatory response (Gauer, 2013). Time to sepsis identification and evidence-based amitotic therapy are critical for preventing sepsis progression to the life-threatening stage of septic shock (Perman, Goyal, & Gaieski, 2012). Despite the availability of evidence-based sepsis guidelines, the mortality rate (10% to 50%) remains higher than the national goals (Schub & Schub, 2013). Both lack of screening and poor identification of early sepsis results in unsatisfactory outcomes (McClelland & Moxon, 2014).

My goal in this literature review was to survey the current scholarly and clinical literature on sepsis, and to determine the available evidence-based management options. Electronic databases that I used to search for scholarly literature included the Cumulative Index to Nursing & Allied Health Literature (CINAHL), PubMed, ProQuest, Ovid Nursing Journals, and Medline. In my searches, I used the following key terms: *sepsis, septicemia, severe sepsis, septic shock, surviving sepsis campaign, sepsis bundle, triage, antibiotic,* and *emergency department*. In order to achieve targeted search results, I used Boolean operators ("and" and "or") to combine terms.

Sepsis Overview

The clinical presentation of sepsis depends on the etiology, including infections arising from the genitourinary, respiratory, gastrointestinal tract, soft tissues, or skin. Generally, the respiratory system is the most common site for sepsis; however, the

genitourinary tract is the most common site for older adults age 65 and above (Gauer, 2013). Older adults, children, immunocompromised individuals, and people with multiple comorbidities are at greater risk for developing sepsis and require close monitoring (McClelland & Moxon, 2014; Schub & Schub, 2013). Older adults are 13 times more likely to develop sepsis and have a 50% greater chance of dying from sepsis, regardless of sex, severity of illness, race, or comorbid conditions (Gauer, 2013).

Surviving Sepsis Campaign

Initially developed in 2002, the SSC was a joint collaboration of the United States Society of Critical Care Medicine and the European Society of Intensive Care Medicine to promote an evidence-based guideline for sepsis identification and management (SSC, n.d.). To reflect the most current research, the guidelines were updated both in 2008 and in 2012, improving the management, diagnosis, and treatment of sepsis (Keating & Lanzinger, 2013). When the SSC was first created, the goal was to achieve 25% reduction in sepsis mortality after five years of implementation. In 2012, SSC goals were enhanced to include: (a) an increase in the number of hospitals that contribute sepsis data to 10,000 worldwide, and (b) a 100% application of the recommended guidelines for patients who are suspected of having severe sepsis and septic shock (Institute for Healthcare Improvement, 2015a).

The Sepsis Bundle

The SSC guidelines for identifying and managing sepsis were outlined in the sepsis bundle. This bundle was the consensus work of a committee with 68 international experts from 30 different organizations. The committee used the Grading of

Recommendations, Assessment, Development, and Evaluations (GRADE) system to establish the strength and the quality of evidence. The first three hours of the bundle are focused on resuscitation, while the latter three hours are specifically focused on managing septic shock. The specific elements included in the care bundle are outlined in Appendix F. Multiple large research studies have demonstrated that the sepsis bundle improves patient outcomes, including decreased mortality by 16% to 28% (El Solh et al., 2008; Nguyen et al., 2012; Rivers et al., 2011).

Experimental Studies

Most experimental studies related to sepsis involve the use of EGDT. Rivers et al. (2011) conducted a prospective, randomized trial that divided 263 eligible participants into an EGDT group and a standard group between March, 1997 and March, 2000. The treatment group received therapy according to a protocol for at least six hours in the ED. The authors reported that the patients in the EGDT group had significantly less in-hospital mortality (30.5%) compared to the standard care group (46.5%). Similarly, a matched cohort study (*N*=174) at a tertiary hospital affiliated with the University of Buffalo reported that older patients treated with the sepsis bundle had an absolute risk reduction of 16% in their 28-day mortality (El Solh et al., 2008). Patients in the treatment group also received larger volume of intravenous fluids (IVF) and lower doses of vasopressors within the first six hours of presentation. Limitations of the study that may have limited its generalizability include the use of a historically-matched control group, small sample size, and a single site of study.

Another study evaluated the impact of utilizing the guidelines set by the SSC in a community-based teaching hospital (Nguyen et al., 2012). Despite receiving similar care regarding appropriate early antibiotic administration (*N*=96), the treatment group (*n*=62) had a higher survival rate (73%) compared to the control group (45%). The difference between the two groups was related to the early fluid resuscitation. The small sample size and the retrospective control group weakened the strength of these findings.

In contrast with the previous studies, Yealy et al. (2014) conducted a randomized controlled trial of protocol-based management specific to early septic shock patients. In 31 emergency departments in the United States, patients (*N*=1,341) were randomly assigned to a protocol-based EGDT group (*n*=439), a protocol-based standard therapy group (*n*=446), and a usual care group (*n*=456). Patients assigned to the protocol-based standard therapy were not required to have central venous catheter placement, administration of inotropes, or administration of bloods. After 60 days, the mortality rate was 21% for the protocol-based EGDT group, 18.2% for protocol-based standard therapy group, and 18.9% for the usual care group. The authors concluded that the use of a protocol-based resuscitation therapy for septic patients did not improve outcomes.

Several other studies have evaluated the association between the timing of antibiotic therapy and mortality. Kumar et al. (2006) conducted a large retrospective cohort study (*N*=2,154) from July 1989 to June 2004 in 14 intensive care units in ten Canadian and U.S. Hospitals. The researchers concluded that administration of the appropriate antibiotic within the first hour of documented hypotension was linked to a 79.9% survival rate. Furthermore, the survival rate decreased by 7.6% for every hour that

antibiotic administration was delayed. Similarly, in a single-center cohort study (*N*=261) conducted from 2005 to 2006 and designed to study EGDT, Gaieski et al. (2010) found a significant association between time from triage to appropriate antibiotics administration at less than the one-hour mark (mortality was 19.5% versus 33.2%). These findings were limited by the small sample size at one hospital. In contrast, Puskarich et al. (2011) did not find an association between the timing of antibiotic administration and mortality after triage. However, they found that a delay in antibiotic administration after the onset of shock is associated with higher mortality. This was a multi-center randomized controlled trial (*N*=291) designed to evaluate the association between the timing of antibiotics and mortality in three urban emergency departments in the United States.

In summary, three studies (Rivers et al., 2011; El Solh et al., 2008; and Nguyen et al., 2012) demonstrated that EGDT guided by the sepsis bundle resulted in improved patient outcomes, including lower mortality. Furthermore, El Solh et al. (2008) reported that patients assigned to the treatment group received higher IVF volumes which lessened the need for vasopressors. Administration of IVFs is an emphasis in the sepsis bundle, especially for patients with elevated lactate levels and/or hypotension. When fluid resuscitation fails, vasopressors are required to support the mean arterial pressure necessary for organ perfusion (Surviving Sepsis Campaign, n.d.). In addition, two studies (Kumar et al., 2006; Gaieski et al., 2010) reported a significant positive effect on outcomes when antibiotic therapy is provided within the first hour of suspected sepsis. However, Yealy et al. (2014) reported that implementation of EGDT did not make any

difference in sepsis mortality. Finally, Puskarich et al. (2011) reported that early antibiotic therapy did not improve outcomes.

Conceptual Framework

I selected Donabedian Healthcare Quality Triad (1966, 1969, 1988) as the evidence-based practice framework to support the project design and implementation. This renowned model shifted the quality improvement paradigm to formally recognize a new healthcare discipline called quality management science (Qu, Shewchuk, Chen, & Richards, 2010). The three domains in the Triad include structure, process, and outcomes.

Structures are the organizational and physical properties where care is rendered (Agency for Healthcare Research and Quality [AHRQ], 2005). This domain may include building and spaces, personnel and policies, and other operation factors for programs. Process refers to the actual providing and receiving of care involving practitioners and recipients. Diagnosing, recommending, and implementing treatment plans are part of the practitioner activities, while seeking care and adhering to treatments are the processes involved for the recipient (Qu et al., 2010). Finally, outcomes are the results of changes in the structures and processes, such as treatment (AHRQ, 2005). This domain validates the effectiveness and quality of the care rendered (Qu et al., 2010).

Various studies (e.g. Whelan & Stanton, 2013; Rondinelli, Ecker, & Crawford, 2012; Gaines-Dillard, 2015) have used the Donabedian Healthcare Quality Triad as the conceptual framework. For example, Whelan and Stanton (2013) used the Triad to guide an intervention to improve safety among patients admitted on telemetry units. Upon review of the cases, the authors found several issues related to patient safety including

monitoring wrong patients, equipment failures, and staff not recognizing arrhythmia. A multi-disciplinary team led by the authors created and implemented evidence-based guidelines that have improved their patient flow and outcomes.

Furthermore, a social action research (SAR) design study that used the Donabedian Healthcare Quality Triad determined the best process to improve the implementation of hourly rounding (Rondinelli et al., 2012). According to their review, there is a lack of evidence specifying the best process to implement this type of nursing routine. At the end of the study, the authors found that the adoption of flexibility is necessary to sustain successful implementation of hourly rounding. They concluded that the continuous reevaluation of both structures and processes helped achieved the desired outcomes. Similarly, evaluating and strengthening structures and processes involved in the management of sepsis patients can help improve outcomes in the organization where my project was implemented.

An advanced-practice, nurse-led, telephone follow-up study designed to improve outcomes among motorcycle trauma patients (Gaines-Dillard, 2015) also used this Triad. The structures included patients who were discharged with recommendations to have an outpatient follow-up, electronic prescriptions, and electronic discharge summaries. Processes involved explanation of discharge and follow-up provided by the multi-disciplinary team, who answered questions regarding hospitalization and discharge, and documented patient's understanding of their conditions upon discharge. Outcomes included a telephone follow-up after three to seven days of discharge, decreased knowledge deficit, and improved communication and patient satisfaction. The author

concluded that the study achieved the goals and that it had the potential to decrease hospital readmissions or ED visits.

The Donabedian Healthcare Quality Triad was applicable to my project because my plan was to alter the structures and modify the processes in the ED to advance positive patient and financial outcomes. For more details about the structures, processes, and outcomes related to the project, see Appendix G.

Summary

In my literature review, I found that the research studies to support EGDT for sepsis were promising, with mixed findings. Likewise, I found that studies evaluating the association between antibiotic timing and mortality were positive or inconclusive. Further research with large sample sizes is necessary to determine if the guidelines set by the SSC can reliably improve patient outcomes.

Section 3: Approach

Project Design/Method

I developed this quality improvement project using the Donabedian Quality Improvement Triad and the Six Sigma DMAIC method. DMAIC is the acronym for the phases Define, Measure, Analyze, Improve, and Control (Kelly, 2011). Six Sigma is a method developed by Motorola in 1986 to enhance product reliability and reduce defects (Fairbanks, 2007). The method has been adopted in health care to promote effective processes that improve workflow and customer satisfaction, and enhance patient and organizational outcomes. In essence, the Six Sigma philosophy is focused on achieving organizational excellence (Fairbanks, 2007).

The first phase of the Six Sigma method is defining the problem, which in the context of my project was the late identification of sepsis and the untimely antibiotic therapy in the ED. This phase also defined the purpose and the scope of the project (Corn, 2009). As I noted in previous chapters, the project purpose was to determine the impact of *Project Code Sepsis* implementation on two quality outcomes. The second phase is establishing the process and/or outcome that need to be measured. The elements measured in my project were the time to antibiotic administration in the ED, and the length of hospital stay among sepsis patients. The third phase is creating a process map and analyzing the failure points and other possibilities to explain poor performance (Kelly, 2011). Based on a retrospective process review and evaluation of data, I found that most patients were not receiving antibiotics within the first hour of their arrival. For example, only 11 of 42 patients (26%) in January 2014 received timely antibiotic therapy

(see Appendix A). My review indicated that antibiotics should be administered within the first hour of suspected sepsis, but regularly were not (Kumar et al., 2006). In addition, I found that patients who met the sepsis criteria in the ED were not diagnosed and treated. For example, 15 of 23 patients (65%) in January 2014 were not diagnosed and treated for sepsis while in ED (see Appendix B). As a result, patients were treated at a later time, following admission, which may have contributed to the lengthening of their hospital stay for sepsis beyond the U.S. national average (see Appendix C). The fourth phase is improving the process by correcting the identified probable causes for failure. This phase involved implementing of *Project Code Sepsis*. The final phase is controlling the revised process so the improvements are sustained (Corn, 2009).

Population and Sampling

The population for this quality improvement project was comprised of adult patients who were admitted through the ED at a tertiary hospital in Southern California. The inclusion criteria were adult patients between the ages of 30 and 85, who were presented to the ED with a diagnosis of possible sepsis, or to rule out sepsis, sepsis, septicemia, severe sepsis, or septic shock. The exclusion criteria included patients with a diagnosis of acute myocardial infarction (AMI), acute stroke, those who required emergency surgery, and those with a "do not resuscitate (DNR)-comfort measures only" advanced directive. For further details about the patient selection process, see Appendix H.

The sampling method that I used for the project was a non-probability consecutive sampling. This is a common method used for quality improvement projects in hospitals

(Flinders University, 2013). Patients who met the inclusion criteria within the specified project period were automatically included in *Project Code Sepsis*. The research evidence demonstrated that quality improvements are probably beneficial, but are not detrimental to patients, and that CMS expects patients to receive the previously described bundle. An important advantage of consecutive sampling is that all available patients are included, which provides a sample representative of the entire population (Flinders University, 2013).

Data Collection

I designed an assessment tool to be used by the triage and ED nurses to screen and identify possible or probable sepsis patients presenting to the ED. Since this was a pilot project, the tool had not been previously tested to assess its content; however, I based the items on the CMS core measures. Originally, I had planned a paper sepsis screening tool for the project; however, the ED management decided to adopt an electronic system because the department is almost paperless. Access to the electronic health record data for each patient was limited to the attending physician and the primary nurse to ensure patient privacy and confidentiality.

Tool

The tool that I created for the project was based on the sepsis core measure criteria released by the CMS (QualityNet, n.d.). Patients who met two or more SIRS criteria, evidence of dysfunction in one or more organ, and a potential source of sepsis were considered as having sepsis. For additional details about the tool, see Appendix D.

Consent

Because this was a quality improvement, process-based project designed to achieve better CMS core measure outcomes and research evidence of patient benefit but not harm, informed consent was not required from patients. Instead, I obtained a letter of cooperation from the Nursing Director for the ED at my project site. I submitted this letter to the Walden University Institutional Review Board (IRB) as part of the review process.

Protection of Human Subjects

In all research studies and quality improvement projects, maintaining the well-being of human subjects, or patients, is a professional responsibility, organizational priority, and societal obligation. Prior to the project implementation, I was granted approval to implement the project from the Walden University's IRB. Protection against physical, psychological, and emotional harm to patients was exercised at all times. In addition, I respected privacy and confidentiality, as required by the Health Insurance Portability and Accountability Act of 1996, throughout project implementation, including the DMAIC process. I stored all individually-identifiable health information in a safe place, and did not share it with unauthorized individuals. I shared only aggregated results, not raw individual data, with stakeholders such as the ED clinicians, ED management, and the Quality Management department. To maintain anonymity, I shared no personal information with third parties and made no personally identifiable data public. Patients were treated equally and fairly throughout the project, no matter their gender, age, or

ability to pay. I respected patient autonomy regarding treatment options throughout the project.

Data Analysis

Data related to the timing of antibiotic administration and length of hospital stay were presented through run charts (see Appendices J and K). I compared the data pre- and post-implementation, three months before and three months after *Project Code Sepsis*. A run chart is the primary measurement tool used in Six Sigma projects to visually review the effectiveness of a program through data displayed over time. The run chart can show how well or poorly a process is performing, and provide longitudinal feedback about the project performance and organizational value (Institute for Healthcare Improvement, 2015b).

Project Evaluation Plan

Project evaluation is necessary to determine the program's effectiveness following implementation. The main purpose is to evaluate the impact of a program on the targeted population. Evaluation should begin during the planning phase and continue until the end of the program (Kettner, Moroney, & Martin, 2013). My evaluation of this project was guided by the Donabedian Triad (structure, process, and outcomes).

I compared the data collected for the three months post-implementation with the data collected for the three months preceding *Project Code Sepsis* implementation. Data were compared on two distinct domains: (a) the time to administration of the first antibiotic, and (b) the length of hospital stay of patients included in the study. I obtained time to administration of the first antibiotic data from the ED electronic medical record

(or PICIS) for each patient. The length of hospital stay was provided to me by the hospital's main electronic medical record (Meditech) upon patient discharge. I analyzed the collected data using a run chart.

Summary

Improving care delivery and therapies rendered to patients through quality improvement projects is an important strategy for achieving better patient and organizational outcomes. The development and implementation of a quality improvement program is a meticulous process that requires careful preparation, diligent execution, and focused measurement. Furthermore, the quality improvement needs to be evidence-based and must demonstrate a clear value to the patient with minimal to no expected harm. Patient confidentiality needs to be protected, privacy needs to be respected, and autonomy insured through clear communication about the benefits and risks associated with each therapeutic intervention. This section provided an overview of the program design, sampling technique, data collection and analysis methods, and evaluation plan.

Section 4: Findings, Discussion, and Implications

Summary of Findings

I implemented the early sepsis identification screening tool for the ED during the last week of July 2015, and gathered and compared data from May 2015 to October 2015. There were 306 patients meeting the inclusion criteria as follows: 40 for May, 48 for June, 56 for July, 61 for August, 53 for September, and 48 for October. I excluded a total of 105 patients with a diagnosis of sepsis because of the exclusion criteria I noted in the previous chapter (two required emergency surgery, two were DNR comfort measures only, four had acute stroke, two had AMI, and 95 were excluded because of the age requirement). A majority of these patients were excluded because they were over 85 years-of-age (*n*=67). However, 25 were adults under 30, and three were minors. Descriptive statistics for the population such as mean age and gender per month are provided in Appendix I. The data related to antibiotic therapy timing and length of hospital stay are provided in Appendices J and K.

Discussion of Findings in the Context of Literature

Implementing antibiotic therapy within one hour of sepsis identification is an essential process improvement strategy for achieving better patient outcomes (Gaieski et al., 2010). As the run chart in Appendix J shows, during the project there was an increasing number of patients who received their antibiotics within one hour of triage time. By the first full month (August) of *Project Code Sepsis* implementation, the goal of providing antibiotics to more than 75% of patients during the first hour of triage was achieved. However, this level was not sustained for the next two months of the project.

Upon review of the medical records, I found that certain health care practitioners documented that 14 patients did not initially demonstrate the signs and/or symptoms of sepsis, but the patients exhibited the signs and/or symptoms at a later time while in the ED. This scenario led to the administration of the antibiotic beyond the target of one hour from triage. In an Australian hospital ED study, Cullen, Fogg, and Delaney (2013) concluded that significant delays in the administration of antibiotic therapy resulted from sepsis not initially being considered as a diagnosis. Furthermore, they reported that the number of years of ED physician experience may correlate with a reduction in sepsis diagnosis delays. For my project, physician experience was one explanation for unrecognized sepsis. With increased experience and better attention to sepsis, senior physicians might be more inclined to order laboratory tests sooner than less experienced physicians. This dynamic may have impacted the timing of the sepsis diagnosis (based on laboratory results) that eventually influenced the timeliness of antibiotic therapy. Nurses' lack of recognition during triage can also affect the early identification of sepsis in the ED. The study conducted by Burney et al. (2012) in a major urban academic medical center reported that more than 85% of nurses are "somewhat" or "not at all" familiar with SIRS criteria. Nurses' experience may also be a factor in the early identification and management of sepsis patients.

Based on the project data, there was no correlation between the number of patients who received antibiotics within the first hour of triage time and length of hospital stay. For example, the month of August had the highest percentage of patients who received timely antibiotic therapy in the ED, but also had the highest length of hospital

stay. Similarly, another study of a nurse-initiated ED sepsis protocol in two academic tertiary medical centers found that in spite of significantly improving the median time of antibiotic administration by 27 minutes, the length of hospital stay was no different between the protocol group and the usual care group (Bruce, Maiden, Fedullo, & Kim, 2015). One explanation for this result may be that the antibiotic therapy does not satisfy the sensitivity profile for the infectious bacteria.

I did not measure the appropriateness of the antibiotic therapy in this project. The only data abstracted was the timing of the first antibiotic therapy. ED clinicians can only retrospectively determine the susceptibility of the bacteria to the antibiotic therapy since culture results are not available for 24 hours or more (Puskarich et al., 2011). A potential solution to maximize the effectiveness of antibiotic therapy for sepsis is to understand the ED bacteria profile for sepsis specific to locally identified common bacteria, and then to use the most effective antibiotic, or combination, for the sensitivity profile.

Another potential for error stemmed from the fact that certain antibiotics have recommended dosages based on patient weight. In this project, I did not collect data related to the appropriate dosing of antibiotics. Under-dosing of medications can cause antibiotic ineffectiveness and resistance that may have contributed to the length of hospital stay.

Another potential reason why the length of hospital stay remained high despite prompt antibiotic administration is that patients may not have received adequate IVFs. Included in the 3-hour sepsis bundle recommended by the SSC, is a guideline for the provision of 30 milliliters of crystalloid fluids per kilogram (Kleinpell et al., 2013). I did

not collect data related to IVF, which might be especially important for patients with hypotension.

Because I did not measure patient acuity related to comorbidities, I did not consider it in relationship to the length of hospital stay. A severity-of-illness score such as those from the Acute Physiology and Chronic Health Evaluation II (APACHE II) variables could provide important data specific to this relationship. If those patients admitted during August had more severe sepsis and septic shock, the high length of hospital stay could be explained.

In summary, antibiotic therapy within one hour of triage time did not improve the overall patient length of stay. This finding is similar to that of Peake et al. (2014), who found no significant difference in terms of length of stay between patients who received EGDT and the usual care. Their study included 51 medical centers in Australia and New Zealand. Furthermore, Mouncey et al. (2015) reported that EGDT actually increased cost and its probability of cost-effectiveness was less than 20%.

Implications

Impact on Practice and/or Action

Evidence-based practice is supposed to result in better patient and organizational outcomes. The implementation of evidence-based practices and strategies to improve patient care is an evolving process among clinicians. Timely interventions that will enhance patient outcomes require a multi-disciplinary approach (Bruce et al., 2015). Nurses are well positioned to lead the implementation of sustainable solutions to improve process and achieve better health outcomes. Evidence-based nursing practice and clinical

performance are critical to improving the early identification of sepsis to prompt timely, goal-directed therapy such as antibiotic administration (Bateson & Patton, 2015). Continuously screening patients for the signs and symptoms of sepsis with a valid tool can be accomplished by nurses in a variety of settings, such as the ED or the inpatient units. Through these strategies, sepsis identification will be accurate and early while the management will be sufficiently timed to improve patient and organizational outcomes.

Impact for Future Research

Research is conducted and project evaluations are completed in order to gain, discover, or test new knowledge. Nurses must continue to conduct quality improvement projects or research studies in order to increase the growing body of knowledge (Bateson & Patton, 2015). Future work related to sepsis management needs to focus on the impact on length of hospital stay and the overall cost of care. However, the work must include the entire clinical guideline instead of only one aspect, such as initial antibiotic therapy. For example, my project has shown that the provision of adequate intravenous fluids, administration of vasopressors as indicated, and the consideration of patient acuity need to be simultaneously evaluated. Furthermore, nurse and physician experiences and the local sepsis bacteria profile might be contributing factors that should be explored in further research. Doctorally-prepared nurses should lead quality improvement projects that promote process evaluation and strategic changes that can manifest as benefits for patients, organizations, and society.

Social Change Impact

Quality improvement projects are critical strategies for clinicians and their organizations to make meaningful changes to produce better outcomes. Continuously refining the way care is provided to sepsis patients can help improve outcomes, such as increasing the number of patients who leave the hospital in good health. Better clinical practices to rapidly identify and promptly treat patients with sepsis can lead to decreased mortality and shorter lengths of hospital stay. Continued project work in sepsis will likely lead to exceptional progress related to disease management.

Economic Impact

The direct cost associated with the treatment of sepsis in acute care settings is estimated to be $24 billion annually. In 2011, AHRQ reported that sepsis represented 5.2% of all inpatient costs. In addition, sepsis was the most expensive disease billed to Medicare with a total of 722,000 hospital discharges (Angelelli, 2016). Early identification leading to timely therapy is essential to prevent the progression of sepsis to septic shock which requires an even greater number of interventions and considerably more costs.

Even though one study concluded that the use of the SSC protocol for severe sepsis increased the cost of care (Suarez et al., 2011), another study showed that early identification and treatment of sepsis can help decrease the overall cost of care. Judd, Stephens, and Kennedy (2014) reported that nurses' use of an electronic sepsis screening tool once per shift improved recognition of the disease, and led to reduced ICU length of stay and decreased cost by about $2,067 per case.

Project Strengths and Limitations

Strengths

The strength of this project included the ED nurses being trained about the screening tool prior to the implementation. This translated into the nurses' familiarity with a screening tool for sepsis by the time the project was implemented. In addition, I used a run chart for data analysis, which clearly depicted progress each month for the timeliness of the initial antibiotic therapy in the ED. Furthermore, because I converted the screening tool from paper to an electronic version, loss of information was minimized since the tool is a permanent part of the electronic health record. This modification prevented paper screening tools from being misplaced or lost during the process of admitting or transferring patients to the floor. Finally, I can continue to collect and analyze project data even after the close of this project.

Limitations

This quality improvement project has several limitations. First, the sample population was small. A large number of patients (n=95) with a sepsis diagnosis were excluded because of the study's age requirement. This exclusion might have changed the results of the project. Second, this was the first time a screening tool was used at this hospital for this specific purpose. Although the tool was developed from the CMS core measure criteria, the content was only evaluated for face and content validity but not reliability. Third, this project was implemented in one hospital ED, limiting its potential for generalizability. Fourth, nurses’ completion of the screening tool was not monitored for accuracy during the implementation. Finally, the urine output element of the sepsis

screening tool was not of value in promoting the initiation of antibiotic within one hour of triage time since it can only be met after two hours of continuous monitoring.

Recommendations for Remediation of Limitations

This project could be continued for a longer period of time, perhaps longitudinally, to increase the sample size and to compare year over year, month over month data. Further, the inclusion age could be opened to all adults over the age of 18 years instead of the closing age of 85. There were 67 sepsis patients over the age of 85. Despite findings in scholarly literature indicating that patients under 30 are at a relatively low risk for sepsis, 18 patients in their 20's were seen and diagnosed with sepsis in the ED. Broadening the age requirement to all adult patients would have provided me more data for analysis.

Another process to strengthen the project would be to test the sepsis screening tool for validity and reliability prior to its implementation. Furthermore, an expert panel could have been used to better establish content validity and to consider improvements. Finally, a pilot testing of the screening tool with some nurses not involved in the program could have informed the content and application of the tool.

Analysis of Self

As a Scholar

The Merriam-Webster Dictionary (n.d.) defines a scholar as “a person who has done advanced study in a special field”. Advanced degrees in nursing are needed to provide a scholarly ethos in health care organizations and to help advance the nursing profession. As a doctorally-prepared scholar, my work should always reflect a purpose.

Implementing this quality improvement project showed that I can lead a process that integrates knowledge into clinical settings.

As a scholar, I was also influential among my colleagues in the organization during the implementation of the project. This is because I was very knowledgeable about the topic and was able to emphasize the importance of managing sepsis promptly.

As a Practitioner

As a health care practitioner, I became keener over the course of the project in the assessment of patients for sepsis. The use of the screening tool made it clearer for me that patients might not just have a simple pneumonia or urinary tract infection (UTI), but may actually be manifesting sepsis as judged by certain clinical indicators. At times, sepsis diagnosis has been missed in the ED (see Appendix B). Without proper diagnosis, some elements in the sepsis bundle may not be executed, which can negatively affect patient outcomes.

Becoming a better practitioner is a personal goal of mine. I approach everyday as a learning experience, and think that it is imperative to consistently strive for excellence. Translating evidence into clinical practice is tantamount to providing the most outstanding care possible. In the end, it is always the patient who will benefit from all of these best practices. As Hampe (2015) has emphasized, the most substantial motivation for a health care practitioner is to see improvement in patient care.

As a Project Developer

Creating, organizing, and leading a project is not an easy task. In order to develop a project, one has to be a leader in the profession. Successful nurse leaders think that their

work is rewarding and have profound connections with their purpose. They establish an environment where all team members work passionately and wholeheartedly to achieve their goals (Smith-Trudeau, 2011).

Developing this quality improvement project related to sepsis management in the ED was a great experience. Nurses reported feeling empowered that they were able to make a difference and had great partnership with other members of the team. This shared governance is a dynamic process that can enhance quality patient care and help in cost reduction (Donohue-Porter, 2012). Being the leader of this project, I felt fulfilled knowing that I was trusted by my colleagues. In addition, the support from multiple individuals showed that the project was a success. I believe that if given another opportunity, I can successfully lead a much bigger project.

What Does This Project Mean for Future Professional Development?

Sepsis is a life-threatening condition that results from a body's reaction to an infection. From 2000 to 2008, the hospitalization rate for this specific disease has more than doubled in the United States (Hall, Williams, DeFrances, & Golosinskiy, 2011). This means that more and more patients are being diagnosed with sepsis, and that health care spending, in turn, is increasing. According to current evidence, early identification and prompt treatment can help decrease mortality and overall costs related to sepsis (Kleinpell & Schorr, 2014).

Nurses play a substantial role in the management of sepsis. They are the first health care personnel the patient sees upon arrival in the ED. Ensuring that nurses are well aware of the signs and symptoms of sepsis by continuous training and education,

and including them in quality improvement projects, can insure that they are to better outcomes. Establishing bigger roles for nurses can intensify and uplift nursing as a discipline.

Summary and Conclusions

A total of 306 patients with sepsis diagnosis were included in this quality improvement project conducted from May 2015 to October 2015 at a hospital ED. The use of a sepsis screening tool was fully implemented during August, a month when more than 75% of patients received their initial antibiotic within one hour of triage time. However, this level was not sustained during the months of September and October. Interestingly, August was also the month of the highest length of hospital stay for sepsis patients.

In conclusion, this quality improvement project did not show that the provision of antibiotic therapy within the first hour of triage time decreases length of hospital stay for sepsis patients. Future studies should include other factors that may affect the results including administration of intravenous fluids and vasopressors, nurse and physician experiences, patient acuity, and local sepsis bacteria profile.

Section 5: Scholarly Product

Executive Summary

Sepsis is a leading cause of death among hospitalized patients in the United States. With more than 200,000 patients with sepsis dying each year, the disease requires early identification and timely intervention. This Doctor of Nursing Practice project, *Project Code Sepsis*, incorporated an evidence-based approach to achieve early sepsis identification and to provide timely evidence-based interventions in the ED.

The purpose of this quality improvement project was to determine if implementing an evidence-based identification and management program in the ED can increase the number of patients who receive antibiotics within the first hour of triage time and decrease the length of hospital stay. More specifically, the primary project goals were: (a) to administer initial antibiotic treatments to more than 75% of patients within one hour of triage time, and (b) to reduce patient length of hospital stay to less than seven days. The hospital outcomes were not within the norm for both objectives.

A sepsis-screening tool was used by the triage nurses and ED nurses to identify possible or actual sepsis patients while they were in the ED. Data related to the timing of antibiotic administration and length of hospital stay were presented in run charts.

A total of 306 patients with sepsis diagnosis were included in this project conducted from May to October 2015. The use of the sepsis screening tool was fully implemented during August, a month in which more than 75% of patients received their initial antibiotic within one hour of triage time. However, this level was not sustained

during the months of September and October. Interestingly, August was also the month of the highest length of hospital stay (7.49 days) for sepsis patients.

This quality improvement project did not show that the provision of antibiotic therapy within the first hour of triage time decreases the length of hospital stay for sepsis patients. Multiple factors, including administration of IVFs and vasopressors for hypotension, nurse and physician experiences, patient acuity, and local sepsis bacteria profile should be considered together in future studies and quality improvement projects. A poster presentation that can be used for the dissemination of my DNP project can be seen on Appendix L.

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Appendix A

Table 1

Percentage of Patients who Received Antibiotic Therapy Within 60 Minutes of Arrival

Month (2014)	Number of Patients Who Met the Criteria	Total Number of Cases	Percentage
January	11	42	26%
February	17	43	40%
March	19	38	50%
April	5	35	14%
May	9	28	32%
June	19	56	34%
July	23	57	40%

Appendix B

Table 2

Percentage of Emergency Department Cases Without Sepsis Diagnosis that Met Sepsis Definition while in the Emergency Department

Month (2014)	Number of Patients Who Met the Criteria	Total Number of Cases	Percentage
January	15	23	65%
February	12	24	50%
March	8	19	42%
April	8	20	40%
May	3	16	19%
June	6	10	60%
July	4	12	33%

Appendix C

Table 3

Average Length of Hospital Stay of Sepsis Patients

Month and Year	Study Hospital	United States National Average	Top 10% in the Nation
August 2013	7.1	6.4	5.4
September 2013	8.4	6.9	5.9
October 2013	8.3	7.3	6.2
November 2013	6.6	7.5	6.3
December 2013	9.2	7.7	6.5
January 2014	7.4	7.0	6.0
February 2014	7.4	7.1	6.1
March 2014	8.3	6.6	5.6
April 2014	6.7	6.7	5.8
May 2014	8.5	7.7	6.5
June 2014	7.2	6.8	5.8
July 2014	6.8	7.1	6.1

Appendix D: Sepsis Screening Tool

Patient Name: _____

Visit Number: _____

- Two or more of the following SIRS criteria:

_____ Temperature of > 100.9 F or < 96.8 F

_____ Heart rate of > 90 bpm

_____ Respiratory rate of > 20/min

_____ WBC of > 12,000/mm3 or < 4,000/mm3 or > 10% bands

- One or more of the following evidences of organ dysfunction:

_____ SBP < 90 mm Hg or MAP < 65 or SBP decrease of more than 40 points

_____ Creatinine > 2.0 or urine output <0.5 mL/kg/hr for 2 hours

_____ Bilirubin > 2 mg/dL (34.2 mmol/L)

_____ Platelet count < 100,000

_____ INR > 1.5 or APTT > 60 secs

_____ Lactate > 2 mmol/L (18 mg/dL)

- Potential source of infection, if known (respiratory, GI, urinary, skin, or other):

_____

Possible sepsis patient? _____ Yes _____ No

RN Name: _____

RN Signature: _____

(Adapted from the Centers for Medicare and Medicaid Services [QualityNet, n.d.])

Appendix E

Table 4

List of Antibiotics Used for Suspected or Actual Sepsis

Condition	Preferred Antibiotics	Alternative Antibiotics	Penicillin Allergy
Non-ICU	Levofloxacin + Ceftriaxone		
ICU	Levofloxacin + Cefepime	Levofloxacin + Ertapenem	Levofloxacin + Aztreonam
Suspected MRSA	Add Vancomycin	Add Linezolid Or Daptomycin	
Intra-abdominal	Ceftriaxone + Metronidazole	Ertapenem	Ciprofloxacin + Metronidazole + Gentamicin
Neutropenic	Piperacillin-Tazobactam Or Doripenem Or Cefepime		Vancomycin + Tobramycin + Aztreonam

Appendix F

Table 5

The Sepsis Bundle

Within three hours of severe sepsis:

(1) measurement of lactate level

(2) drawing of blood cultures prior to antibiotic administration

(3) administration of broad-spectrum antibiotics

(4) administration of 30 milliliter/kilogram (ml/kg) of crystalloids for lactate $\geq$ 4 millimole/liter (mmol/L) or hypotension

Within six hours of signs and symptoms of septic shock:

(5) utilization of vasopressors (to keep mean arterial pressure $\geq$ 65 millimeters of mercury [mm Hg])

(6) measurement of central venous pressure (CVP) and central venous oxygen saturation (SCVO2) for persistent arterial hypotension or initial lactate of $\geq$ 4 mml/L

(7) measurement of lactate level again if the initial one was elevated

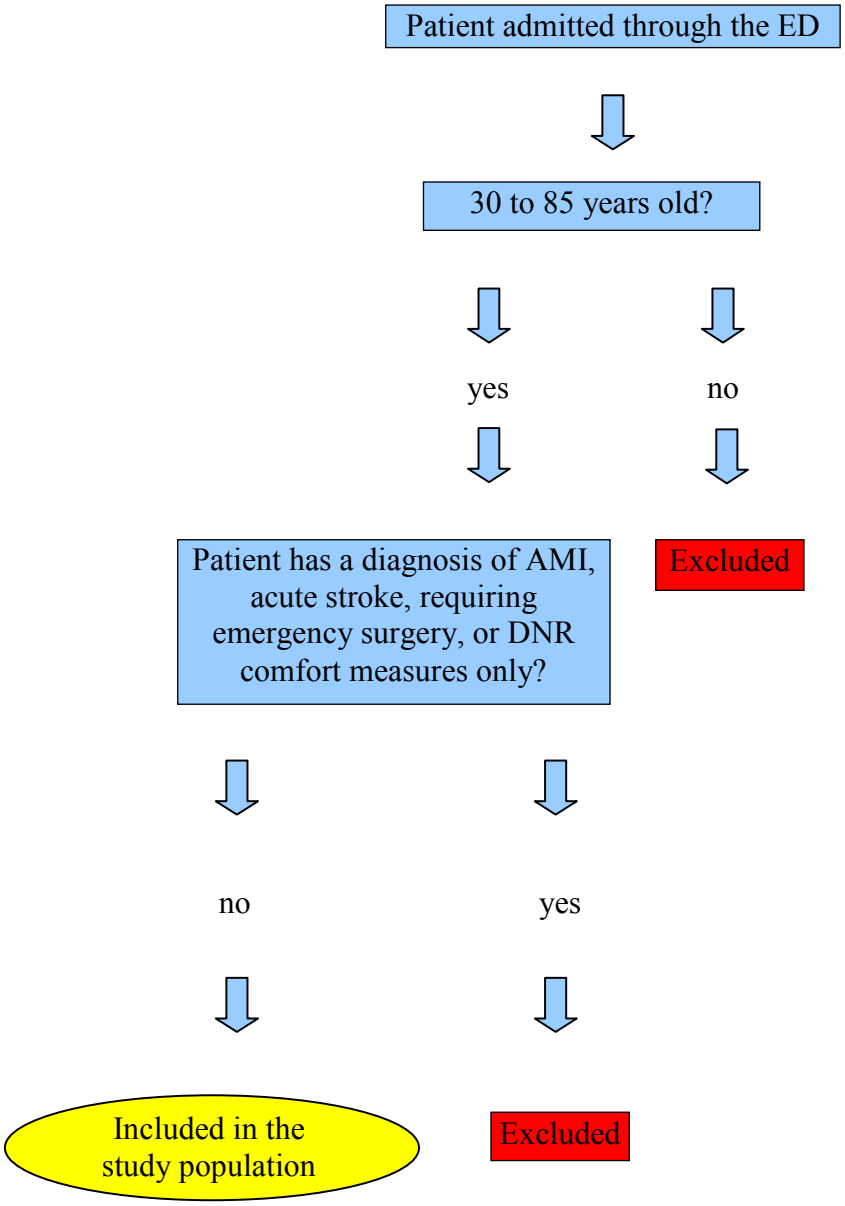
Appendix G

Table 6

The Donabedian Healthcare Quality Triad

Structures
• Emergency department of a tertiary hospital • Patients (30 to 85 years-of-age) admitted through the ED who meet the inclusion criteria • Emergency department registered nurses, physicians, advanced practice nurses (APNs), physician assistants (PAs), and laboratory personnel
Processes:
• Emergency nurses screening and assessing patients for signs and symptoms of sepsis • Informing physicians, APNs, and PAs of possible or actual sepsis patients • Ordering of laboratory tests and appropriate antibiotics • Administration of prescribed antibiotics by the ED nurses
Outcomes
• More than 75% of patients will receive their initial antibiotic within one hour of triage time • Patients' length of hospital stay will average less than seven days

Appendix H: Patient Selection Process



Appendix I

Table 7

Characteristics of Patients by Age and Gender

Month (2015)	Mean Age	Male
May	69.6	52.5%
June	65.7	50%
July	60.1	48.2%
August	66.7	54%
September	60.2	66%
October	63.5	60.4%

Appendix J

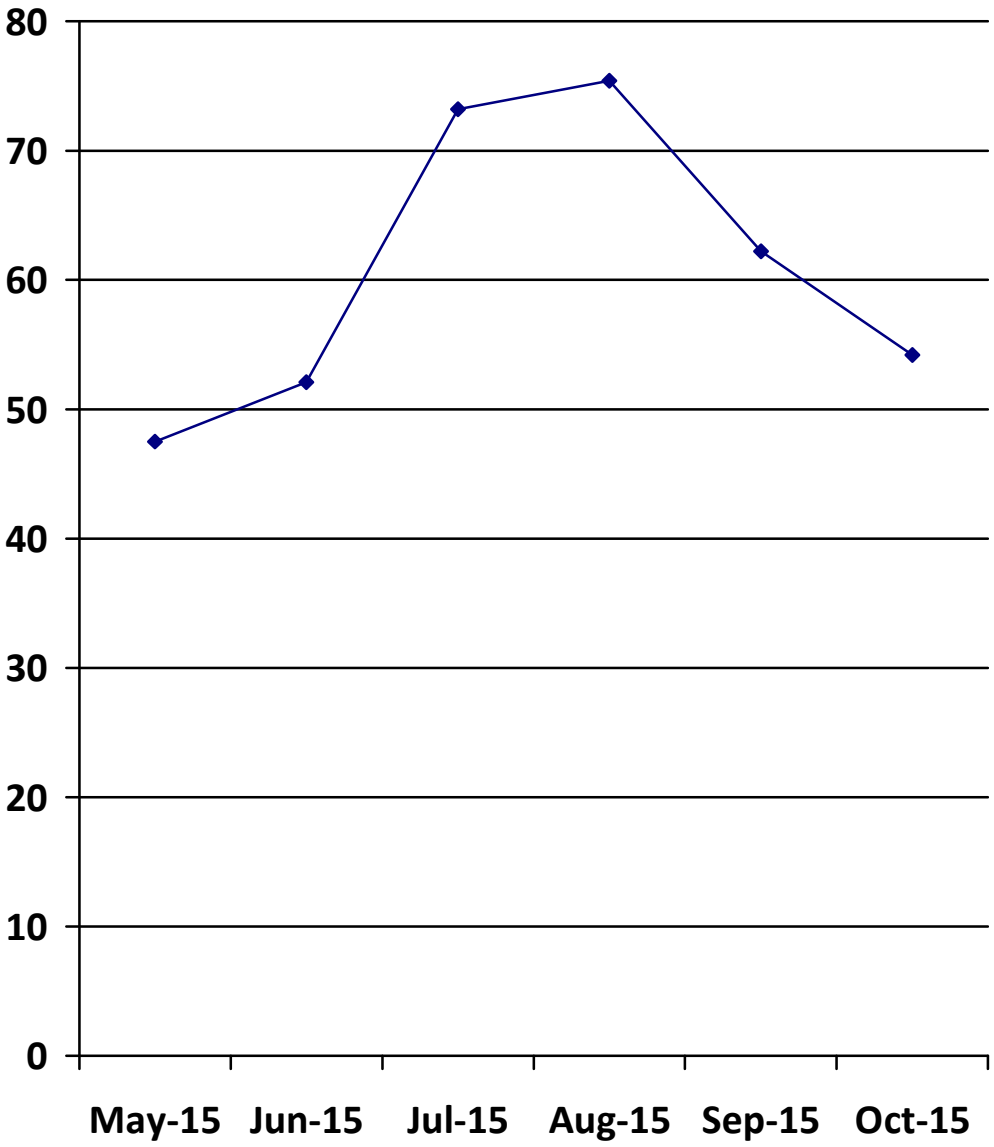


Figure 1. Percentage of patients who received an antibiotic within one hour of triage time.

Appendix K

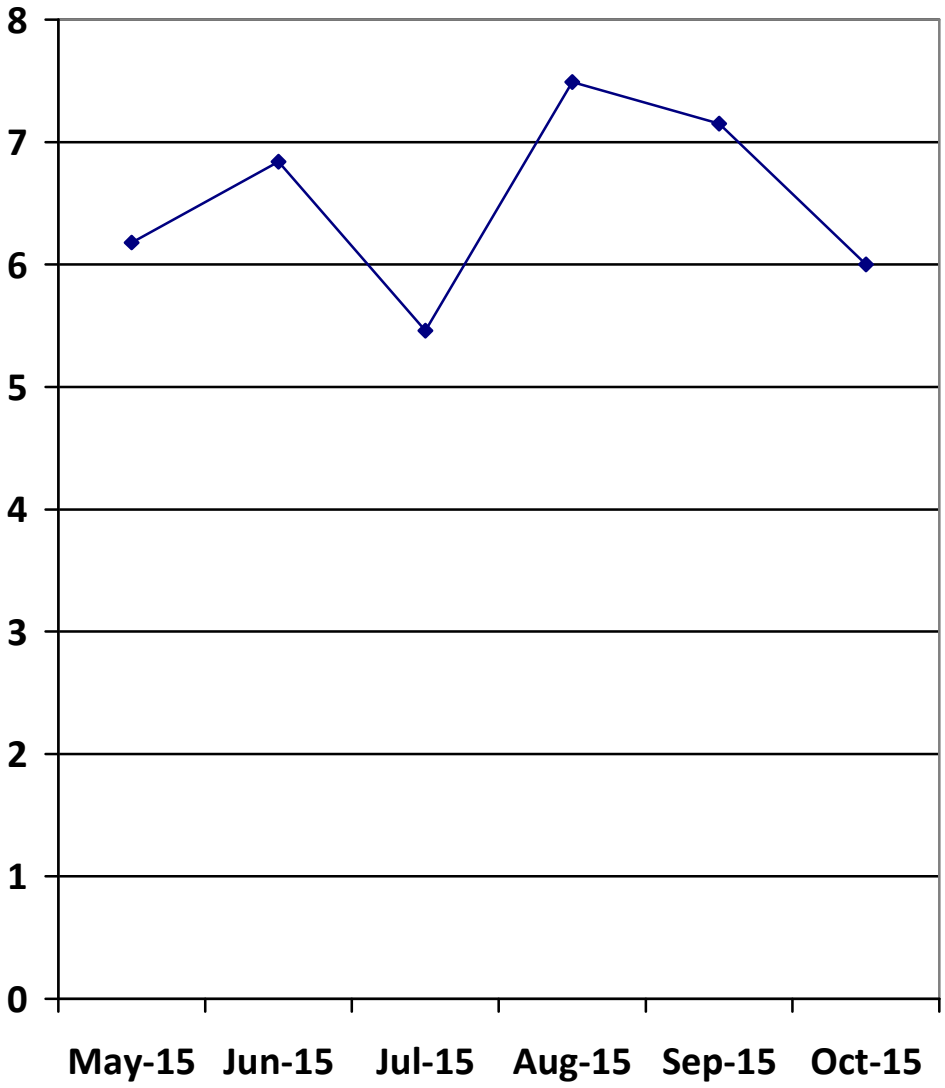


Figure 2. Sepsis patients length of hospital stay in days.

Appendix L

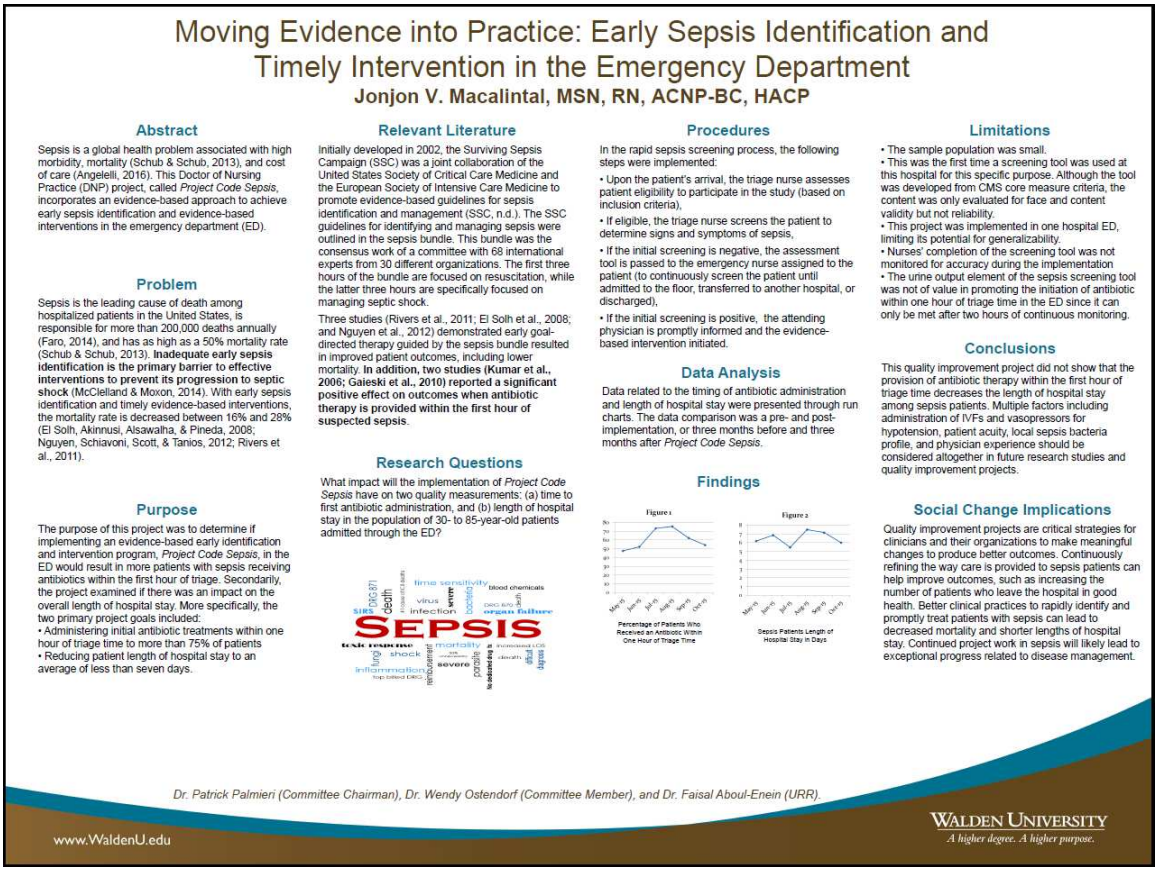


Figure 3. A poster presentation for the dissemination of the DNP project.