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Reducing Mortality from Severe Sepsis and Septic Shock: A Macro System Approach

Scott D. Baker
University of San Francisco, scotterrn@gmail.com

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Scott David Baker DNP(c), MSN, RN, CEN, CNL, NEA-BC

University of San Francisco

Committee Members:

Juli Maxworthy DNP, MSN, RN, CNL, CPHQ, CPPS, CHSE

Elena A. Capella EdD, MSN/MPA, RN, CNL, CPHQ, LNCC

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Abstract

Healthcare organizations must be able to provide quality patient care from arrival to disposition that is both expedient and safe. The Agency for Healthcare Research and Quality ranks septicemia as the number one most expensive condition treated in U.S. hospitals, resulting in aggregate costs of $20.3 billion or 5.2% of the total aggregate cost for all hospitalizations. Starting October 2015, the Centers for Medicare & Medicaid Services began tying financial reimbursement to improvement of sepsis outcomes. For success to be achieved, organizations should partner with prehospital providers to improve sepsis care, similar to partnerships which have historically improved acute myocardial infarction and stroke care within communities. Activation of the 911 system, coupled with rapid prehospital assessment and priority transport, including pre-notification to the receiving emergency department, creates opportunities for accurate and timely diagnosis, along with implementation of lifesaving treatment immediately upon arrival or even in route. This project sought to improve recognition and treatment of sepsis through partnerships with our prehospital providers. Through education and collaboration, we saw improvement in recognition of the septic patient in the prehospital environment, leading to improved outcomes. These outcomes demonstrated reductions in mortality from severe sepsis and septic shock and a 1.5-day per patient reduction in overall hospital length of stay for DRGs 870, 871, and 872, resulting in an estimated cost savings of $3.1 million for the organization. Partnering with the community to educate and improve awareness and early recognition demonstrates potential in improving survival and reducing costs.

Keywords: severe sepsis, septic shock, septicemia, prehospital, mortality

Section II. Introduction

Background

Severe sepsis imparts a significant burden on the U.S. healthcare system, affecting approximately 750,000 persons annually, with an estimated mortality rate of 30% and annual costs of $16 billion (Studnek, Artho, Garner, & Jones, 2012). A review of Sutter Health's data of patient mortality from severe sepsis and septic shock, coupled with recommendations for sepsis care outlined under the 6-hour bundle, led to the formation of a multidisciplinary care team from Sutter Health affiliate hospitals and participation in a sepsis care summit and collaborative meetings to improve sepsis mortality. The U.S. Department of Health and Human Services, National Center for Health Statistics, notes that the number and rate per 10,000 population of hospitalizations for septicemia or sepsis more than doubled from 2000 to 2008 (Hall, Williams, DeFrances, & Golosinskiy, 2011) (see Appendix A for graphical representation). Discussions regarding the nature of sepsis and strategies for early detection and treatment resulted in each affiliate developing a sepsis task force with a goal of improving care and saving lives. As a system, Sutter Health tracks mortality from severe sepsis and septic shock for its 22 affiliate hospitals on a monthly basis. Between February 2014 and January 2015, of the 8,112 patients diagnosed with severe sepsis or septic shock diagnosis, 1,554 died, resulting in an organization-wide mortality rate of 19.2% (see Appendix B for comparison graph).

Similar to polytrauma, acute myocardial infarction (AMI), and stroke, the speed and appropriateness of therapy administered in the initial hours after severe sepsis develops are likely to influence outcome (Dellinger et al., 2013). Every year, severe sepsis strikes more than a million Americans with estimates showing that between 28 and 50 percent of these people die, far more that the numbers of U.S. deaths from prostate cancer, breast cancer and AIDS combined

(Torio & Andrews, 2013). According to the Surviving Sepsis Campaign International Guidelines, timely recognition and early goal-directed therapy (EGDT) have been shown to improve survival of patients presenting with severe sepsis and septic shock (Dellinger et al., 2013). Similar to the American Stroke Associations *Stroke Chain of Survival*, there exists an opportunity to improve sepsis care and mortality through rapid recognition and timely activation of the 911 system. This activation, coupled with rapid prehospital assessment and priority transport, including pre-notification to the receiving emergency department (ED), creates the ability for an accurate and timely diagnosis, along with implementation of EGDT immediately upon arrival or even in route.

While much work is being done to improve mortality from severe sepsis and septic shock within healthcare organizations, little work has been done to involve healthcare providers in the prehospital setting, where up to half of the patients with a diagnosis of severe sepsis arrive. Research indicates that left untreated, mortality from septic shock rises by 8% an hour (Cronshaw, Daniels, Bleetman, Joynes, & Sheils, 2011). Due to an aging population, the costs and incidence of sepsis will continue to rise; partnering with prehospital providers will be instrumental in increasing awareness and reducing mortality.

A 2010 study looked at the management of sepsis and septic shock by emergency medical services (EMS) and determined that less than one-third of patients with severe sepsis received fluids in the prehospital setting, indicating an opportunity for improvement (Seymour et al., 2010). Despite the large number of patients treated by out-of-hospital providers, prehospital education had been lacking in this area. Results of a web-based survey of 226 EMS providers demonstrated poor understanding of the diagnosis and management of sepsis (Baez, Hanudel, Wilcox, Perez, & Giraldez, 2010).

The Centers for Medicare and Medicaid Services (CMS) are now requiring hospitals participating in Inpatient Quality Reporting (IQR) program to collect data for the Severe Sepsis and Septic Shock: Management Bundle measure (NQF #0500), which began October 1, 2015 (Hospital Quality Institute, 2015). With mortality rates ranging from 16% to 49% and sepsis being one of the top 10 causes for hospitalizations, CMS's adoption of this management bundle measure requires organizations to improve sepsis care. Not only is adherence to the new international sepsis bundles important for patient safety and quality by improving timely recognition and initiation of EGDT, organizations will now have financial incentives tied to reimbursement from the federal government. With the introduction of reporting sepsis quality measures to CMS, severe sepsis and septic shock will surely gain more recognition in order to improve outcomes similar to AMI and stroke measures, which required mandatory reporting years ago. As seen in the past, prehospital providers will play critical roles in partnering to improve timely care and financial incentives for sepsis outcomes.

Local Problem

In 2012, Sutter Health's severe sepsis and septic shock mortality rate was 25% (Townsend, 2015). An opportunity was recognized to save 700 lives, if top decile performance could be achieved by improving recognition and treatment. In early 2014, sepsis experts from across the system convened to evaluate the evidence-based guidelines of high performing organizations across the country. This work group developed sepsis standard work for the EDs, inpatient units, and intensive care units (ICUs) across the Sutter Health system. This resulted in a system wide quality and process improvement project, introducing the new 6-hour standardized bundles in late 2014 and was implemented at six Sutter Health affiliates, with positive outcomes and improvements in mortality. Sutter Roseville, one of the first affiliates to go live with the

new initiative, documented a 50% reduction in mortality from sepsis, while the five other affiliates, following Sutter Health Roseville's lead, reduced sepsis mortality to an average of 19%. Cronshaw et al. (2011) noted that research has shown that adherence to the bundles improves outcomes in patients with severe sepsis; yet, reliable delivery of the bundle remains a challenge in many healthcare organizations, resulting in higher mortality rates.

Memorial Medical Center (MMC) consistently documents the highest number of patients with a diagnosis of severe sepsis and septic shock within the Sutter system. Of the 8,372 patients reported system wide, MMC documented 959 septic patients, accounting for 11.5% of the total system wide cases between March 2014 and March 2015. Of this total, MMC documented 210 deaths, resulting in an average mortality rate of 21.9%. With more scrutiny tied to average length of stay (ALOS) with regards to CMS pay-for-performance, it is important to note that ALOS for those hospitalized for septicemia or sepsis compared to those hospitalized for other conditions had a length of stay (LOS) which was two times longer (Hall et al., 2011) (see Appendix C for graph representation).

In February 2015, MMC's sepsis task force was directed to go live with the new 6-hour bundle initiative beginning June 1, 2015 in a weeklong event to kick off our campaign. In preparation for the June go-live date, a sepsis multidisciplinary improvement committee was developed, which consisted of the ED, ICU, and hospitalist physician champions, along with members from the ED, ICU, and medical/surgical units' nursing leadership and frontline staff. The committee also had representation from ancillary services, including laboratory, pharmacy, and nursing supervision. The manager for emergency and trauma services and the ED educator, who also served in the role of the sepsis champions for the system wide sepsis initiative, facilitated the committee. The committee began monthly meetings in February 2015 and

increased the frequency to twice monthly starting in March 2015 to review the standardized work compliance, evaluation of the process mapping for the 6-hour bundle initiative, and to stay on top of trends in data.

The team recognized in July of 2015 that MMC could not successfully impact the mortality and LOS for severe sepsis and septic shock without developing partnerships within the community to increase recognition. Partnerships with Mountain Valley Emergency Medical Services Agency (MVEMSA), who transports 911 traffic to the facility, was instrumental in making positive impacts in mortality and LOS reduction. Initial data collected demonstrated that over half of our annual severe sepsis and septic shock population arrived by EMS. Evaluating processes for improving EMS recognition and initiation of timely treatment were key to the success of the project.

Intended Improvement and Purpose of Change

Hospital costs continue to grow faster than the economy, and the health share of the gross domestic product has maintained its upward trend, reaching 17.9% in 2011 (Torio & Andrews, 2013). Sepsis is associated with high mortality rates and remains a serious global health condition, despite improvements in our ability to manage infections. The Surviving Sepsis Campaign's updated and re-published guidelines serve as the basis for evidence-based care in the recognition and treatment of sepsis. See Appendix D for a description of the 3- and 6-hour bundle requirements. Utilizing the Surviving Sepsis Campaign guidelines, we sought to partner with MVEMSA, our ED providers, and inpatient leaders and their teams to improve the overall resulting mortality from sepsis within MMC through education and collaboration.

Organizations must be able to provide quality care from arrival to disposition that is both expedient and safe. Utilizing Toyota Lean methodologies in an effort to improve timeliness and

quality of care, a process improvement team was formed, with a focus on improving sepsis identification and implementation of EGDT starting in the prehospital environment and ending with discharge from the facility. Our goal was a reduction in mortality from severe sepsis and septic shock to less than 18% facility wide by August 2016.

Through coordination of care at the microsystem, mesosystem, and macrosystem level, based on data analysis of outcomes and ongoing education, sustainable change will be possible to impact the timely recognition of sepsis and the reduction in overall mortality within the facility. Embracing change and modeling behaviors of transformational leadership will be essential to the introduction of new evidence-based practice initiatives within the setting of MMC in order to improve efficiency, outcomes, mortality, productivity, and profitability (See Appendix II for project Letter of Support). It is imperative that nursing leaders understand, effect, and manage change in order to have prolonged, sustainable results.

Review of the Evidence

Utilizing Cochrane, Cumulative Index to Nursing and Allied Health Literature (CINAHL) and PubMed databases, a literature search was completed utilizing the following terms: *sepsis, severe sepsis, septic shock, septicemia, emergency department sepsis, intensive care unit sepsis, critical care sepsis, sepsis care pre-hospital,* and *emergency medical services sepsis.* In order to assure the most up-to-date evidence-based practice guidelines, the literature searched was in English, with a publication date within the last decade. Articles selected for inclusion had to evaluate prehospital identification and treatment of the septic patient and sepsis care within the ED setting. These criteria assured that the focus of the literature addressed the proposed hypothesis: Partnerships with prehospital EMS and facility inpatient departments and implementation of sepsis-specific education, with an emphasis on identification, early

notification, and timely treatment under the 3- and 6-hour bundles, would improve overall patient mortality and LOS from sepsis to below 15% by July 2016. Articles were excluded if the study did not address the identification, care, and transfer of the septic patient within the prehospital, ED, or inpatient units. Twenty-two articles were identified during the search, with nine articles meeting the specific requirements for inclusion and chosen to use in the review for this paper.

Review of the evidence was completed utilizing the John's Hopkins Nursing Evidence-Based Practice Model, Non-Research Evidence Appraisal tool (Dearholt & Dang, 2012). This model utilizes specific steps for identifying the practice question and leadership responsibility, evaluating the evidence, developing recommendations, and translating evidence for practice change and includes a rating scale for strength of evidence and quality for both research and non-research evidence (Schaffer, Sandau, & Diedrick, 2013). The tool utilizes five levels of strength of the evidence presented in the articles and measures the quality of the evidence using an A, B, C rating system. Level one receives the highest rating and represents experimental studies with randomized controlled trials (RCT) and meta-analysis of RCT's; level two measures quasi-experimental studies; level three is utilized for non-experimental studies, qualitative studies, and meta-synthesis; level four is used for systematic review and clinical practice guidelines; and level five is organizational, expert opinion, case studies, and literature reviews. The quality ratings are specific around the appraisal of evidence that is research driven. These ratings range from high quality (A rating), good quality (B rating), and low quality or evidence with major flaws (C rating). See appendix E and Appendix I.

Carlbom and Rubenfeld (2007) assessed written protocol barriers to implementation for EGDT for severe sepsis in the busiest EDs in the U.S. The design of their study consisted of a

telephonic survey questionnaire with both qualitative and quantitative analysis for two of the busiest teaching and non-teaching EDs in 25 most statistically and densely populated areas of the United States. The ED medical directors and nurse managers of these departments identified multiple barriers in implementing time-sensitive bundles for patients with severe sepsis. The critical shortage of nursing was voiced by more than half of the respondents as the main barrier, with problems obtaining central venous pressure monitoring and issues with early identification of patients with sepsis as the biggest hurdles to overcome when implementing EGDT (Carlbom & Rubenfeld, 2007).

Cronshaw et al. (2011) wanted to assess the recognition and management of patients presenting with severe sepsis and septic shock across three hospital EDs. Retrospective data were collected for patients in the ED with a diagnosis of sepsis over a 3-month period. Of the 255 patients identified for the study, 17% (44/255) had documentation of sepsis by ED staff. The College of Emergency Medicine standard of care was received in 41% of those with a documented diagnosis of severe sepsis while in the ED and 23% of severe sepsis or septic shock overall. Eighty-nine percent of patients received treatment, including oxygen, IV antibiotics, and IV fluids; although, 12 patients with an elevated lactate failed to receive fluid resuscitation. Seventy-one percent of patients with severe sepsis or septic shock had no documented discussion or consideration for admission to the ICU. Cronshaw et al. concluded that the Surviving Sepsis Campaign has had some impact on sepsis; but there is a long way to go in identifying and treating septic patients presenting for care.

MacRedmond et al. (2010) investigated the effectiveness of a comprehensive management protocol for quick recognition and initial treatment of severe sepsis from the ED to the ICU in a tertiary teaching hospital. They developed a management algorithm, which

included EGDT, computer physician order entry (CPOE) order sets for suspected sepsis, utilization of hemodynamic monitoring, and antibiotics readily available in the ED, coupled with extensive education involving ED nurses and physicians. Following the management algorithm, the authors documented a decrease in hospital mortality for severe sepsis from 51.4% to 27.0%. MacRedmond et al. concluded that the introduction of a comprehensive management protocol addressing early recognition and management of severe sepsis in the ED was associated with improvements in recognition and care of this patient with severe sepsis.

While researching the impact of EMS on the ED care of patients with severe sepsis, Studnek et al. (2010) discovered that patients who received EMS care prior to ED arrival experienced a 35-minute decrease in the time to antibiotic administration and a 41-minute decrease in the time to initiation of EGDT, as compared to patients who were not treated and transported to the ED by EMS. When discussing the importance of their findings, they felt that care of the septic patient in the prehospital environment would improve the overall rapid initiation and course of treatment for patients presenting to the ED and would ultimately be inexpensive and only require simple changes to the EMS care process. Studnek et al. acknowledged that increasing EMS provider's ability to recognize sepsis prior to ED arrival demonstrated an increased response time in EGDT, as compared to those patients who did not have sepsis recognized.

Guerra, Mayfield, Meyers, Clouatre, and Riccio (2012) sought to determine if EMS providers trained in sepsis recognition and guided by a sepsis alert protocol would be able to recognize severe sepsis utilizing measurement of venous lactates and initiation of standardized treatment, similar to those utilized in cardiac and stroke alert protocols, to improve outcomes, if treatments for shock were initiated prior to arrival. Of the 67 patients transported by trained

EMS personnel, 32 were identified as being in severe sepsis and initiated the sepsis alert protocol. Trained personnel failed to identify 35 of the 67 patients diagnosed with severe sepsis upon arrival to the ED. This is the first study conducted in the United States that utilized venous lactate monitoring devices in the prehospital environment as a means of identifying patients with sepsis. The results of the study demonstrated the need for further research in order to validate the use of a sepsis alert protocol in the prehospital system and any associated decrease in mortality (Guerra et al., 2012).

Over a 10-year period, Seymour et al. (2012) conducted a large community-based cohort study, which demonstrated that prehospital providers frequently care for patients hospitalized with severe sepsis. In the study, consisting of 407,176 total EMS transports to the ED, crude incidence rate for severe sepsis was 3.3 per 100 EMS arrivals, which was greater than AMI at 2.3 per 100 and stroke at 2.2 per 100. Results demonstrated that 80% of severe sepsis patients transported by EMS were diagnosed upon admission to the ED, not in the field, and more than half met systemic inflammatory response syndrome (SIRS) criteria for heart rate and respiratory rate. Interestingly, on-scene times ranged from 35 to 50 minutes, with an average transport time of 12.6 minutes to the ED (Seymour et al., 2012).

Band et al. (2011) conducted a study of 963 patients with a diagnosis of severe sepsis and septic shock to evaluate the time to EGDT, specifically with regards to door to antibiotic, initiation of intravenous fluids, and hospital mortality in patients who either arrived by EMS or walk-in methods. Results demonstrated a median time to antibiotics of 116 minutes for EMS patients, as compared to 152 minutes for non-EMS patients. For initiation of intravenous fluids, EMS patients saw a median time of 34 minutes, while non-EMS patients had a median time of 68 minutes. Band et al. concluded that prehospital care was associated with improved processes

regarding initiation of EGDT; yet, despite improved ED treatment times in the patients who arrived by EMS, there was no benefit with improvement in mortality.

In 2009, Wang, Weaver, Shapiro, and Yealy performed a prospective review of 4,613 patients who presented to their urban ED with serious infections and admission to the hospital to evaluate opportunities for EMS involvement in sepsis care. Of the total patients studied, 1,576 received initial care by EMS, with an 8% (126 patients) mortality rate, compared to 3,037 who did not arrive by EMS, with a 2.2% (67 patients) mortality rate. Of note, prehospital personnel provided care to over one-third of the patients who arrived in this study, and these patients were more likely to arrive with organ dysfunction than patients arriving by walk-in methods. The authors concluded that simple interventions could improve prehospital personnel's ability to identify sepsis, such as oral or tympanic temperature combined with hypotension to identify shock. Wang et al. felt that significant skill and resource expansion would be required for EMS integration into hospital-based sepsis protocols, so that prehospital personnel could recognize, start treatment with EGDT, and implement early notification to the ED for patients with sepsis.

A study conducted by Femling, Weiss, Hauswald, and Tarby (2014) sought to determine any differences in outcomes from sepsis between patient arrival modes. The study included 485 patients – 378 arriving by EMS and 107 who walked into the ED. Patients arriving by EMS were typically older, had increased altered mental status, and were ultimately triaged to the highest priority for care, compared to patients presenting by walk-in mode. Though patients arriving by EMS experienced shorter time to antibiotics and central line placement, the researchers concluded that both groups of patients experienced equal mortality and overall hospital LOS. Of note, patients who received large amounts of IV fluids in the prehospital environment experienced no improvement in mortality, but did experience an overall shorter

LOS (5 days compared to 10 days) than those not receiving prehospital fluid resuscitation. One of the key points of the study was that clinicians are not aggressive enough with treating septic patients in the prehospital environment, and EDs must place stronger emphasis on early recognition and treatment for walk-in patients, who are not viewed as being as sick as the EMS population (Flemling et al., 2014).

All of the studies reviewed were those of expert opinion based on scientific evidence (Level IV) and of high or good quality (A or B) based on the John Hopkins tool (see Appendix E and Appendix I). Each of the studies reviewed demonstrated some success with prehospital involvement in the recognition and treatment of patients with potential sepsis complications or success with implementation of EGDT within the ED and ICU. While only one of the studies identified reductions in mortality within the ED to ICU environment, none of the studies identified reductions in mortality between recognition in the field and patients who directly self-reported to the ED; although, there were positive findings with improvement in time to antibiotics and initiation of EGDT. Regardless of the number of patients treated by prehospital providers, education regarding sepsis identification is lacking and needs to be addressed in order to improve care and outcomes.

Conceptual / Theoretical Framework

To assure the results of the project, the DNP scholar chose John Kotter's eight-step change model as the theoretical framework to guide the evidence search and review. Following the eight-step process, Kotter's change model assisted in guiding the evidence-based quality improvement project and in setting the path for achieving the desired improvements in overall quality outcomes through early identification of sepsis within the prehospital and hospital system to improve overall mortality rates. Anticipating resistance to change, creating standardized

work, and validating the standardized work was instrumental for the facility to achieve and maintain sustainability with sepsis improvement.

Kotter (2007) asserted that organizational change can be managed using a dynamic, nonlinear eight-step approach. The fundamental eight-step approach consists of (1) increase the urgency for change, (2) build a team dedicated to change, (3) create the vision for change, (4) communicate the need for change, (5) empower staff with the ability to change, (6) create short-term goals, (7) stay persistent, and (8) make the change permanent**.** In order to sustain long-term change with bundle compliance and improve mortality, there must be motivation and incentive to do so at the staff, physician, and administrator level within the Stanislaus County system and MMC.

Education, engagement in the process, and overall buy-in is critical to sustainable success. Engagement and education of team members within the prehospital system and throughout the facility on the importance of utilizing evidence-based practices regarding early and timely recognition of sepsis and implementation of the sepsis bundles have proven to impact overall mortality rates for patients with potential sepsis and septic shock. Influential behavior modeling by the county's EMS administration, the hospital's administrative team, nursing unit leadership, and physician champions was necessary to affect positive change in all front-line staff members. Strong prehospital buy-in, along with staff member, physician, management, and executive support embracing and modeling the new behaviors, allowed for sustainable change to occur.

Studnek et al. (2010) noted that during the last several decades, emergency medical services have developed an important role in the initial management of patients with life-threatening injury and illness, and prehospital providers are required to accurately recognize

these acute life-threatening conditions and provide resuscitation and airway management, in addition to expeditious transport to the most appropriate medical care facility. For these reasons, prehospital personnel have the ability to impact overall mortality of patients with severe sepsis and septic shock by timely notification and rapid transport to the appropriate ED, where EGDT can by initiated immediately.

Section III. Methods

Ethical Issues

The University of San Francisco Doctor of Nursing Practice department approved a statement of determination (Appendix F) as a non-research improvement project; therefore, it was not submitted to the Institutional Review Board (IRB). It was deemed a process improvement project and, therefore, did not require IRB approval. Additionally, as a quality improvement project, all data abstracted from the electronic health record, along with all data from the EMS pre- and post-education surveys, were de-identified in order to protect anonymity and remain compliant with laws under the Health Insurance Portability and Accountability Act (HIPAA).

From an ethical perspective, this project set out to do what's morally right for patients with sepsis. With more emphasis, especially within the prehospital and community setting, rapid identification and initiation of early treatment can and will save lives. A report from the CDC found that 80% of patients diagnosed with sepsis developed the condition outside of the hospital and seven in ten patients with sepsis recently used health care services or had chronic diseases requiring frequent medical care (Novosad et al., 2016). These are opportunities for healthcare providers to prevent, recognize, and treat sepsis long before it can cause life-threatening illness or death. Our responsibilities as advocates for our patients, drives the impetus to improve education, early recognition, and timely treatment not only to save lives but also to reduce costs and improve our ability to provide quality, cost effective care always.

While this project concentrates its efforts on the identification and treatment of sepsis in the prehospital environment and rapid notification to the receiving emergency department, the results may be of minimal help if as a nation, we fail to look at readmissions for patient

discharged with sepsis complications. A retrospective cohort analysis of hospitalization from 2009 to 2011, used a large statewide database to show that about 20% of hospitalizations for sepsis, resulted in re-admission within 30 days of hospital discharge (Chang, Tseng & Shapiro, 2015). Because of its higher prevalence, the total cost of 30-day re-admissions for sepsis was greater than that of CHF and AMI combined; from 2009 to 2011, the annual cost of 30-day readmissions for sepsis in California was approximately $500 million per year, more than twice that for CHF at $229 million per year, and over three times that of AMI at $143 million per year (Chang, 2015).

Torio et al., point to recent reports from the Agency for Healthcare Research and Quality (AHRQ) which demonstrate the U.S. healthcare system spends more money on hospitalization for sepsis than any other cause. From an ethical standpoint, re-admissions impact quality of life and place increased burden not only on the patient and their family, but our healthcare system as a whole. Where is the justice in improving recognition and treatment on the front end, only to have patients return as re-admissions within 30 days? If we are to truly impact sepsis mortality and costs, involving the community in identification and treatment prior to admission, along with support and follow-up post discharge, will be critical in reducing re-admissions and further mortality.

Setting

Stanislaus County is located in the central valley of California between the metropolitan areas of Fresno and Sacramento. The county population is 518,336, based on a 2013 census (Stanislaus County Community Health Assessment, 2013). Within the county exists five acute care hospitals, two of which are Level II trauma centers. All five hospitals partner with MVEMSA, along with Mercy Air Transport, to receive patients from the outlying communities

of the Sierra Foothills and throughout Stanislaus and San Joaquin counties. American Medical Response (AMR) holds the primary contract for 911 services in the county, with oversight from MVEMSA. Twenty-three ambulances are in service daily, supporting the counties 911-service needs.

Memorial Medical Center is a 423-bed tertiary care facility located in Modesto, California and an affiliate of the not-for-profit Sutter Health system. The hospital maintains an average daily inpatient census of 235 patients. Although there exists the ability to flex up to 423 beds, staffing has been a limiting factor in our ability to flex beyond 210 to 235 patients per day. The hospital serves as an ST segment elevation myocardial infarction (STEMI) receiving facility, an accredited chest pain center, a Joint Commission designated primary stroke center, and an American Society of Metabolic and Bariatric Surgery (ASMBS) accredited bariatric surgery center. Additionally, the facility is an American College of Surgeons designated cancer center and Level II trauma center. There also exists a family birthing center with a Level II neonatal intensive care unit (NICU) and a da Vinci Robotic surgery program. Memorial Medical Center has the ability to impact sepsis care and mortality on a daily basis. MMC's 44-bed Level II trauma center and emergency department experienced 83,000 annual patient visits in 2015 and admits 25% to 30% of its volume to the inpatient units daily as reported in from 2015 budget data tracked by our finance department. Volumes have continued an upward trend, as more individuals are now covered through the Affordable Care Act and due to growth from Sutter Health's recruitment of members into its insurance plan.

Planning the Intervention

In order to improve mortality from sepsis, partnering hospital sepsis reduction initiatives with EMS was crucial to success. This improvement project was implemented to reduce hospital

LOS and mortality from complications of severe sepsis and septic shock to below 18% by partnering with the prehospital system. The goal was to improve recognition, initiate treatment in the prehospital environment, and institute a pre-notification to the receiving ED.

The implementation plan for sepsis improvement included education to hospital nursing and EMS staff on sepsis recognition and treatment through the Surviving Sepsis Campaign's 3- and 6-hour bundles. Additionally, the creation of EMS sepsis treatment protocols and a sepsis alert from the field was critical to the success of the program. All data from the project were collected monthly through retrospective chart review from the EPIC electronic health record, EMS prehospital run sheets, and diagnosis-related group (DRG) sepsis data from the facilities finance department. In order to evaluate the success, six months of data were collected pre-project implementation and five months of data were collected post-project implementation.

Spanning 18 months, MMC began to address the process for reducing mortality and overall LOS for our severe sepsis and septic shock population. Following a thorough analysis of the data regarding hospital sepsis mortality and LOS, along with the ability of EMS to recognize the patient with sepsis complications, guided the improvement project. The aim of the project was to increase sepsis recognition utilizing SIRS criteria within the prehospital and hospital system. The demand for achieving improvement is substantiated in an article by Studnek et al. (2012), which documented the significant burden of severe sepsis on the U.S. healthcare system, affecting 750,000 persons annually, with an estimated mortality rate of 30% and annual costs of $16 billion.

In February 2015, MMC documented a combined mortality rate from severe sepsis and septic shock at 25%. We hypothesized that through partnerships with prehospital EMS, facility inpatient departments, implementation of sepsis-specific education emphasizing identification,

early notification, and timely treatment under the 3- and 6-hour bundles, we would improve patient mortality from severe sepsis and septic shock to below 18% and reduce overall ALOS for sepsis DRGs by one day by August 2016.

A 2-hour Power Point presentation on sepsis recognition and treatment guidelines, highlighting the Surviving Sepsis Campaign's recommendations under the 3- and 6-hour bundles, was developed by a multidisciplinary care team from Sutter Health affiliate hospitals during the sepsis care summit in 2014. This education was rolled out to all affiliates between 2014 and 2015, as part of the education plan for all hospital nursing staff. The objectives for the hospital training included:

- Understand sepsis definitions and basic pathophysiology.
- Understand the elements of both the 3-hour and 6-hour bundles.
- Understand the new standard work for RNs with regards to sepsis screenings, rapid response team (RRT) activations, and the difference and utilization of sepsis and code sepsis alerts throughout the facility.
- Demonstrate understanding and use of the sepsis summary in the electronic medical record document flow sheets.
- Understand when and why best practice alerts fire and the necessary follow-up actions.

Sepsis alert and code sepsis protocols were created as part of the facility notification system to activate hospital resources when a patient met criteria for sepsis. A sepsis alert, used to identify a patient with potential severe sepsis, was paged overhead when an infection was suspected with two or more SIRS criteria being identified. A code sepsis was paged overhead to identify a patient with possible septic shock when the severe sepsis patient remained hypotensive

despite fluid resuscitation or a lactate greater than 3.9 mmol/L. See Appendix H for MMC sepsis screening Q&A staff education sheet.

Although we did not have a thorough understanding of EMS personnel's knowledge of sepsis and septic shock, we knew education would be instrumental if we were going to be able to impact overall mortality and LOS. Using Survey Monkey, a 13-question survey was developed and administered in late January and early February 2016 to 314 paramedics and emergency medical technicians (EMT) working within the EMS system in Stanislaus County. The multiple-choice survey assessed pre-education knowledge of sepsis definitions, severe sepsis and septic shock signs and symptoms, treatment recommendations, and national statistics regarding mortality, race, ethnicity, and socioeconomic status (see Appendix G). Participation in the survey was mandatory for all individuals attending the symposium and annual education sessions. There were no incentives offered for completing the survey. The survey was created under this author's Survey Monkey account, with a link sent out to MVEMSA's educator to distribute to all individuals signed up to attend both events. Results for both surveys were anonymous and contained no specific identifying factors other than whether the individual taking the survey was a paramedic or an EMT. Results were received immediately upon survey respondent's completion. After calculating the results, the data were shared with county EMS leadership both pre- and post-educational offerings. The information gathered from the pre-education assessment was utilized to develop the presentation for the educational sessions.

The education on severe sepsis and septic shock, *Improving Sepsis Recognition: Achieving Success through Pre-Hospital Partnerships,* was initially presented to 89 EMS providers during the Stanislaus County Regional Pre-Hospital Cardiovascular Conference on February 11, 2016. Following the conference, the same educational presentation was presented

to 225 EMS providers within AMR during their six annual educational sessions for 2016. To assess post-education knowledge, the same survey administered through the Survey Monkey site, with questions posed in different order, was printed in hardcopy format and administered immediately following all sessions in an effort to obtain knowledge assessment immediately following the education.

Cost Benefit Analysis / Return on Investment

A plan was developed to improve mortality from severe sepsis and septic shock while reducing overall LOS. A budget associated with the implementation of the project was designed to outline the cost associated with the initiative (see Appendix J for detailed budget). As an organization, Sutter Health had experienced a documented 25% combined mortality rate from severe sepsis and septic shock, with no consistent improvement since June 2014. While there are no means of associating a human's life with a monetary value, there exists a way of calculating return on investment (ROI) through reduction in overall LOS.

Mountain Valley EMS Agency transports more than 50% of MMC's severe sepsis and septic shock volume into our facility through the ED (see Appendix K). Prior to project implementation, we hypothesized that identifying patients with complications of sepsis and initiating therapy prior to ED arrival would have positive impacts on mortality and overall hospital LOS. Initial pre-project LOS data collected between July 2014 to June 2015 demonstrated that reducing LOS by one day for each patient would amount to a savings of $1,898,100, more than covering the costs of the project (see Appendix L). With this data, we hypothesized these reductions could be possible and might yield rewards not only for improving patient care and reducing mortality, but financially through reductions in overall LOS, producing potential cost savings in the millions of dollars.

Following the project kickoff in June 2015, data collection continued in order to evaluate the outcomes of the project's overall success with reductions in LOS and mortality. Data collected identified 1,141 patients treated over the 12-month project period (see Appendix M for overall patients admitted by department). Based on total patient volumes, we broke the data down into ALOS by department (see Appendix N). In order to calculate total days by department, we multiplied patient census within each department by ALOS in each department to obtain 9,644.7 total patient days from all departments. Between July 2015 and June 2016, MMC reported an estimated 9,644.7 total patient days related to diagnoses with sepsis complications, as calculated by sepsis DRGs 870, 871, and 872 (see Appendix O). These DRGs accounted for an estimated $18,324,930 in total costs to care for patients with sepsis complications between July 2015 and June 2016 (see Appendix P).

A comparison of the pre-project and post-project data on total patients and ALOS by department, demonstrates an ALOS reduction of 0.2 to 0.5 days per department by the end of the project (see Appendix Q). We calculated total cost avoidance by multiplying each department's total reduction in ALOS, by total sepsis patient volume from each department, by the average costs of care across all three DRG's (see Appendix R for Post-Project Cost Avoidance from ALOS reductions). Upon evaluation of our budget and project investment of $150,824.13 (Appendix J) and our overall cost avoidance of $926,060.00 through reductions in ALOS, we calculated a total ROI of $775,235.87 (see Appendix S Return on Investment/Cost Benefit Analysis).

Implementation of the Project

The program was implemented in three phases over 18 months (Seep Appendix EE for Communication Plan). Phase I included the development of the MMC sepsis improvement team,

who reviewed the standardized work and process mapping in preparation for the mandatory education of all nursing staff (See Appendix FF & Appendix GG for Project and Hospital Stakeholder Message Mapping Diagrams). Two hours of mandatory education on sepsis identification, care, and treatment was required to be completed by all nursing staff within the facility. Additionally, all nursing staff onboarding with the organization after June 2015 were required to have the same two hours of education on sepsis recognition and treatment within the facility. All initial education for the facility's registered nursing staff was completed prior to our go-live date on June 1, 2015.

Phase II began on June 2, 2015 with the implementation of the project go-live week within the hospital environment. During this week, corporate summit team members supported sepsis team members to assure processes were in place for a successful implementation. These team members rounded throughout the hospital during the week, assuring that the 3- and 6-hour bundles were implemented correctly, evaluating the standardized work, and answering any questions from staff and physicians in order to assure success of the program. This phase also included post-implementation data metric monitoring and reporting mortality rates each month moving forward in order to track progress of the program.

Phase III involved partnering with our county EMS provider to discuss dissemination of education and training for early recognition of sepsis in the field. More than one-third of ED patients with an infection and patients with severe sepsis and septic shock received their initial care from prehospital personnel in 2011 (Guerra et al., 2012). Prior to and during transport to the facility, fluid boluses would be initiated in order to improve EGDT immediately upon arrival to the ED (See Appendix GG for EMS Message Mapping Diagram). Treatment protocols, developed to improve recognition and treatment of the septic patient in the prehospital

environment, began utilization in April 2016, following training with our EMS partners in February and March 2016 (see Appendix T for Prehospital Treatment Guidelines).

Implementing the project required increasing the urgency for change by presenting current mortality rates within the facility and by building a sepsis committee team dedicated to the change. Creating a vision for the change and communicating the need for the change was accomplished during educational sessions with hospital and prehospital team members through demonstration of our ability to save lives with simple screenings and timely treatment. Following the sepsis education, hospital and prehospital team members felt empowered with the ability to change processes, resulting in positive outcomes for patients through timely recognition, treatment, and notification. Short-term goals were created to increase the incidence of SIRS screenings within the ED and inpatient units, which allowed for timely treatment and overall reductions in mortality. We remained persistent in our efforts through the monthly presentation of data to the sepsis committee, executive team, and prehospital leadership, in addition to the commitment for continuation of education for staff during new hire orientations and annual skills labs. Finally, we were capable of making our change permanent by creating standardized work processes and consistently communicating the positive efforts of all team members through data showing reductions in mortality on a monthly basis.

Planning the Study of the Intervention

Planning the study of the intervention resulted in a detailed plan created during the system wide sepsis Kaizen event in April 2015. Following the Kaizen event, the initial priority centered around the mandate from Sutter Health corporate to educate nursing staff on the sepsis 3- and 6-hour bundles in preparation for MMC's go-live date of June 2015. A 2-hour Power Point presentation was created outlining national, system, and local facility level sepsis statistics,

in addition to education specifically focusing on identification, notification, and treatment under the new bundle initiatives. The objective of the training was to educate the facility's 894 nurses, including nursing leadership, on severe sepsis and septic shock and to empower the entire nursing team to move into action when patients were identified as experiencing complications from sepsis, whether in the outpatient or inpatient setting. Again, importance was placed on the rapid identification, notification, and initiation of lifesaving treatment within the hospital and prehospital environments in order to positively impact mortality and overall facility LOS for patients with sepsis complications.

Methods of Evaluation

Our performance goals were measured through data abstraction of patient diagnosis for sepsis from the electronic health record and reported to the sepsis improvement team, along with facility and corporate stakeholders, on a monthly basis. Additionally, data were collected by the finance department, looking specifically at sepsis DRGs by department 12 months pre- and post-project implementation.

A SWOT analysis was completed, which identified that the organization's strengths included a lengthy working relationship between the county EMS and the facility. Additionally, the organization staffs a dedicated EMS liaison employed by MMC who partners with and bridges the relationship between the facility and EMS partners. Memorial Medical Center boasts a state of the art ED, with nearly 24,000 square feet of patient care space, including a new $3.5 million expansion and the ability to staff 52 beds during high census situations. The hospital employs a highly skilled, dedicated staff, with low employee turnover and excellent environment of work satisfaction scores. Sutter Health is a not-for-profit, large hospital system, with the ability to offer great educational resources and updated state of the art equipment fostering

excellent patient care. Memorial Medical Center staffs 13 nurse educators, who partner facility wide to offer a wide range of educational opportunities in order to improve outcomes. The facility utilizes EPIC as its electronic health record, a system which is intuitive, user friendly, and allows for excellent data collection. The department also staffs a dedicated informatics nurse capable of accessing multitudes of data. The facility has an extremely engaged executive team, with support from the corporate level, allowing a constant focus on patient safety, improving the patient experience, and assuring that the team has the tools needed to support patient care.

Included as weaknesses are physician biases to any new process implementation; many existing processes have been in place without change for years. In addition to dated processes, there also existed a lack of physician leadership engagement and complacency among the ER and hospitalist provider groups with regards to change. The 6-hour bundle, a Sutter Health initiative with standardized protocols and work, was created by a multidisciplinary care team during the system sepsis care summit and led and supported by the system's chief medical officer, with a goal of standardizing care across the system. Because the work was standardized at the system level, ED physicians and the medical director of the intensivist program felt they had no voice in the development of the standardized work and lacked the ability to deviate from the system wide standardized work; although, the work had been developed based on evidence-based practice initiatives. Initially, their concerns led to non-compliance with bundle initiatives for care and treatment of the septic patient and lack of consistency between the ED and ICU.

Opportunities exist to improve the identification and treatment of sepsis initiation within the prehospital system with timely notification to the ED while in route in order to expedite care and treatment on arrival. There also exist opportunities to improve recognition of sepsis

complications with the community through education similar to initiatives with STEMI and stroke. Partnering with the Sutter Gould hospitalist group, which does not work directly for the hospital, was key in obtaining timely admission assessments and inpatient admission orders to facilitate movement to the ICU for higher-level of care and treatment. Additionally, we recognized in June 2016 that working with the long-term acute care centers and skilled nursing facilities would be beneficial, as a large percent of their populations are sent to local EDs for care, especially with regards to sepsis complications. Education with these facilities could improve recognition of the patient with sepsis complications and timelier access of the 911 system. The most impactful opportunity will be lowering our mortality rates and saving lives of patients through early recognition and rapid implementation of fluids to improve sepsis outcomes in the prehospital environment.

Threats to the project's success and sustainability were initially attributed to the lack of commitment, coupled with strong resistance from the EMS medical director, whose primary focus had been on trauma, STEMI, and stroke initiatives. Another threat in the beginning resulted from a new project MVEMSA initiated utilizing protocols for psychiatric patients on 5,150 holds and the ability to bypass the ED and transport the patient directly to the psychiatric treatment facility for admission. This project was the first of its kind in California and a primary focus, requiring many resources from MVEMSA in order to assure its success. Similar to physician bias, there existed biases from paramedics to follow the protocols for treatment under the guidelines, specifically with fluid resuscitation in patients with potential renal failure or congestive heart failure. Failure to partner in education with the long-term acute care centers and the skilled nursing facilities could result in a lack of recognition and early notification for a large

population of chronically ill patients, impacting overall mortality negatively (see Appendix U SWOT Analysis).

Analysis

The initial analysis of the pre-project data indicated room for improvement in the reduction of mortality and costs associated with administering care for our severe sepsis and septic shock population. This was validated through our assessment of the data for July 2014 to June 2015, which demonstrated a combined mortality rate consistently above 20% (see Appendix V).

The analysis of our pre-project data regarding combined sepsis mortality and ALOS data assisted in our development of the sepsis education for the staff nurses within the facility. Our analysis of our EMS partner's recognition of the severe sepsis and septic shock patients prior to arrival in the ED pre-project implementation demonstrated an immediate need for partnership and education in order to improve recognition and ultimately reduce mortality. Of the 120 pre-project EMS charts reviewed prospectively, 12 of the 120 transports resulted in an outcome of mortality (see Appendix W: 2015 EMS Sepsis Recognized versus Not Recognized and Appendix X: 2015 EMS Sepsis Expired versus Lived on Recognized Cases). The analysis of the pre-project EMS chart review identifying recognized versus not recognized, along with our Survey Monkey assessment of EMS personnel's understanding of sepsis and its treatment (Appendix G), guided the development of our presentation on sepsis in order to improve recognition of the patient with sepsis complications and the new prehospital treatment protocols.

A review of the data following EMS education demonstrated improvement in recognition of the sepsis patient prior to arrival at the ED and improvement in the number of patients recognized who experienced mortality after arrival (see Appendices Y, Z, and AA).

Additionally, a review of the post-project data demonstrated a reduction in ALOS of 0.2 to 0.5 days per department by the end of the project (see Appendix Q). A reduction in the mortality rates for severe sepsis and septic shock, combined and separated, also demonstrated success with the overall project (see Appendix V and Appendix BB).

Section IV. Results

Program Evaluation and Outcomes

The success of the program was evaluated through monthly metrics abstracted from total sepsis cases and the impact to overall mortality reduction for the facility and system, along with data specific to EMS recognition of sepsis pre- and post-project. Outcome measures included ALOS data from all inpatient units accepting severe sepsis and septic shock diagnoses for admission. Data collection started in June 2015, comparing EMS recognition versus non-recognition of the septic patient prior to arrival to the ED for all EMS patients with a final coded diagnosis of sepsis (see Appendix W and Appendix X). As part of the project's final outcomes, data were compared to pre-project data on EMS recognition versus non-recognition following the education and implementation of the EMS sepsis treatment protocols (see Appendix Y and Appendix Z). Hospital data were analyzed over the year and compared to data post-project implementation in order to track progress towards our goal of a reduction in mortality below 18% by July 2016 (see Appendix V and Appendix BB for historical and current trends in mortality improvement).

To assure bundle compliance and appropriate care, improvements were measured through monthly data analysis and chart reviews completed for any patient death resulting from a diagnosis of sepsis. Variances were controlled through open, constant communication with sepsis team members, physicians, administration, and front line staff, along with consistent follow through for bundle compliance associated with the care and treatment of our septic population. Data were shared monthly with the hospital quality improvement committee, sepsis improvement team, and leadership in order for the organization to better understand our progress towards the goal. We also shared our data regarding EMS recognition and non-recognition of

the septic patient, along with total facility LOS and combined mortality, as we moved towards partnership in identification, treatment, and education with our prehospital team members.

Evaluating the project involved assessing multiple quantitative data metrics to determine progress and success with the program. Questions posed as part of the evaluation process were:

- Did EMS crews recognize and utilize the sepsis treatment protocols in at least 90% of cases transported to the emergency department?
- Were all patients who screened positive with two or more SIRS criteria identified with a pre-notification to the emergency department?
- To what extent did initiation of the EMS sepsis treatment protocols improve pre-notification to the emergency department?
- Was there an overall reduction in average length of stay?
- Was there an overall reduction in the combined mortality rates for severe sepsis and septic shock?
- Given the results, did the money spent result in a return on investment from reduced length of stay?

Initial data collected between June 2015 and November 2015 assessed prehospital personnel's ability to recognize sepsis prior to ED arrival. Following the sepsis education, during the EMS cardiovascular symposium and AMR educational sessions, for the 314 county EMS providers in February 2016, an additional five months of data from February 2016 through June 2016 was collected to evaluate the effects of the training on their ability to recognize sepsis in the prehospital environment. The data assessment was collected to assess pre- and post-learning in order to evaluate whether there was an increase in the recognition of sepsis in the

prehospital environment. Since this was a quality improvement project, all data were de-identified to protect patient confidentiality.

Our EMS base nurse liaison evaluated EMS data run sheets for 100% of patients arriving monthly as part of our data collection process. Data collected included the following information and were reported in a similar format as the data documented in Appendices Y and Z.

- Which patients were identified as having complications from sepsis in the field versus after arrival to the emergency department?
- Which patients met SIRS criteria?
- Was a sepsis alert called to the emergency department prior to arrival?
- What was the average length of stay for all patients arriving with sepsis complications (see Appendix N)?

In June 2015, our finance department started collecting retrospective data by department on ALOS for all sepsis patients within the organization between July 2014 and June 2015. These data allowed us to see the potential positive effects from our efforts under the new 3- and 6-hour bundles and from the new EMS sepsis treatment protocols, specifically in regards to fluid resuscitation and the impact on overall hospital LOS for DRGs 870, 871, and 872. Our finance department determined each hospital day associated with these specific sepsis DRGs have an estimated cost of $1.900 per day, demonstrating reductions in ALOS would result in cost savings for the facility and patient (see Appendix CC).

Since August 2014, we have assessed monthly data in order to evaluate our improvement efforts in mortality reductions from severe sepsis and septic shock. We reported these metrics in

our monthly sepsis improvement committee meeting, which was then shared at the executive team level during their monthly meetings (see Appendix V and Appendix BB).

Section V. Discussion

Summary

Increased mortality within the organization established an impetus for change in our approach to recognition and treatment of severe sepsis and septic shock within our patient population driving the implementation of this project. The project focused on implementation of the 3- and 6-hour treatment bundles from the 2012 Surviving Sepsis Campaign. In order to ensure improvement, a macrosystem approach involving prehospital providers was crucial to success. Data collected prior to the project's implementation substantiated the need for immediate change. Sutter Health documented mortality from severe sepsis and septic shock at 25% in 2012. Within the organization, an opportunity was recognized to potentially save 700 lives by improving recognition and treatment. Experts from across the Sutter system convened to evaluate evidence-based guidelines in early 2014 in order to initiate processes to improve sepsis care.

Documenting the highest number of patients with a diagnosis of severe sepsis and septic shock within the Sutter system, MMC realized an opportunity to impact the care of our patients. We documented 959 patients with severe sepsis and septic shock, resulting in 11.5% of the system's total cases between March 2014 and March 2015. Of the 959 cases, 210 resulted in death, creating an average mortality rate of 21.9%. Our goal of reducing mortality to less than 18% facility wide, while also reducing our overall hospital LOS, would require education and process improvement initiatives within the facility and through partnerships with EMS.

With persistence and hard work, we were able to partner with and educate 894 nursing staff and 314 EMS personnel with a macrosystem approach to reducing mortality and LOS for patients presenting with complications from sepsis. Based on our data, we were able to improve

overall EMS recognition of the patient with sepsis complications with final June 2016 data, demonstrating recognition and notification at 100%. We documented a septic shock mortality rate of 19% in April and 21% in June (See Appendix BB for graph representations of Septic Shock mortality reductions). Severe sepsis saw an overall downward trend over the length of the project, finishing out July 2016 at 3% (See Appendix BB for graph representations of Severe Sepsis mortality reductions). Starting in September 2015, we documented a combined mortality rate consistently at 21%, finishing out June 2016 at 15.6% (See Appendix V for graph representations of combined mortality reductions).

The most impressive results from the project came in the reduction in LOS and ROI. Reducing overall LOS between 0.2 to 0.5 days per department by the end of the project led to a cost avoidance of $926,060.00. When subtracting the total investment in the project of $150,824.13 from the cost avoidance, we arrived at a ROI of $775,235.87. When evaluating the mortality and LOS reductions, partnering improvements in the recognition and treatment of severe sepsis and septic shock with EMS and hospital initiatives proved to be a successful venture.

Relation to other Evidence

A recent study published in collaboration with the Centers for Disease Control (CDC) asserts that sepsis is a significant public health and clinical management challenge. The study found that routine healthcare encounters should be utilized as opportunities to implement interventions around increasing vaccination coverage, educating patients and families about early sepsis warning signs, improving infection control programs, and optimizing chronic disease management are likely to have a substantial impact on reducing sepsis (Novosad et al., 2016). Findings from their analysis determined that patients with sepsis experienced severe illness and

serious adverse outcomes, which led to long hospital stays (median 10 days), and among all patients with sepsis, 72% experienced a healthcare factor in the month preceding admission or a chronic condition likely to require frequent contact with the healthcare system.

The CDC is set to launch a comprehensive campaign, partnering with organizations representing clinicians, patients, and other stakeholders, in the hopes of demonstrating that prevention of infections through vaccinations and patient education on early recognition of sepsis will be integral to overall patient safety and reductions in mortality. While partnering with EMS in sepsis recognition and early notification to the ED has improved treatment and resulted in decreasing LOS and mortality, efforts to educate the community, skilled nursing facilities, and long-term acute care centers will be critical to further reduce complications and death from sepsis.

Barriers to Implementation / Limitations

Barriers to project implementation and its success existed and required mitigation as they arose. The first barrier encountered was one of competition for resources. By happenstance, the MMC Lean Promotional Office scheduled an additional Kaizen event between the ED and the renal telemetry unit for the week of June 1, with a focus of improving decision to admit through evaluation and improvement of patient throughput from the ED to the inpatient care environment. Though there was some initial concern voiced regarding the two events occurring during the same week, the administrative team was dedicated to supporting both initiatives and creating success between both implementations.

A second barrier was the ability for the hospitalist team to evaluate and write admission orders in a timely manner in order to expedite the admission of the code sepsis patient to the ICU for higher-level care and improvement in bundle compliance. The result was a partnership

between the intensivist and the hospitalist, which created timelier initiation of orders by the intensivist. When a code sepsis was paged overhead, the intensivist on duty would arrive within 10 minutes and write orders for the patient in order to continue the 6-hour bundle.

Finally, working with MVEMSA was initially problematic, as they were an outside agency, which was not initially interested in tackling sepsis recognition and improvement of sepsis care within the prehospital environment. Major barriers experienced by most institutions in the United States include identification and rapid treatment of septic patients and resistance to changes in practice (MacRedmond et al., 2010). From a quality improvement perspective, MVEMSA's medical director had a primary focus on AMI and stroke populations and, initially, was not interested in implementing sepsis treatment protocols and providing education on sepsis in order to improve recognition in the field.

Additionally, MVEMSA had initiated a 1-year project in April 2015, the first of its kind in California, which utilized protocols by EMS for assessing 5,150 psychiatric patients and bypassing the ED to transport them directly to the psychiatric treatment facility for admission. Their leadership felt that they had too many initiatives occurring at that point in time and did not feel that adding another process would be beneficial or a good use of resources. During the initial meeting in August 2015, the DNP scholar presented data on the evidence around sepsis mortality and the impact of early adoption by EMS systems around the nation and in other countries regarding early recognition and treatment. After this initial meeting, MVEMSA desired to continue their focus on AMI and stroke improvement and felt as an organization that they would not be able to add the focus of sepsis to their agenda and 2016 metric outcomes.

Motivated to obtain their support in our sepsis initiative, six months of retrospective data were collected through chart review of every EMS encounter from June 2016 to November 2016,

specifically looking at every patient transported to MMC's ED with a final diagnosis of severe sepsis or septic shock. The data abstracted looked at patients who were recognized versus not recognized as having sepsis complications by EMS and assigned an overall mortality rate. Initial data abstracted from June 2015 through November 2015 included 264 patients transported with either severe sepsis or septic shock. The EMS personnel recognized 112 patients with sepsis complications, of which seven were included in the mortality numbers following admission. Emergency medical services failed to recognize 152 patients transported with sepsis complications, of which 22 were included in the mortality numbers following admission (see Appendix Z). These data demonstrated that patients recognized with sepsis complications prior to arrival in the ED had lower mortality rates than those not recognized, justifying the need for education of EMS personnel on sepsis identification and treatment.

In December 2015, this DNP scholar again met with MVEMSA's medical director, executive director, and clinical educator to discuss the results of the data collected. A proposal, which included a draft prehospital treatment protocols along with an education plan, was presented and offered to be facilitated by our team in an effort to reduce the resources required by MVEMSA. Impressed with the EMS sepsis recognition versus non-recognition data, draft field treatment protocols, and education plan, MVEMSA's leadership agreed to move forward with a partnership on sepsis identification, treatment, and pre-notification alerts to all Stanislaus County EDs starting on April 1, 2016.

Time and Cost Summary

The components of this project required significant amounts of time and financial resources resulting from monthly committee meetings, workshops, and education requirements for all current registered nursing staff prior to project implementation and all new registered

nursing staff hired following implementation. Partnering with MVEMSA involved significant time resources and political savvy. The quality improvement project depended heavily upon the partnering relationship between a county organization and not-for-profit hospital entity.

The overall timeframe for this project was estimated at 18 months due to facility wide implementation, Sutter corporate oversight, and external involvement with our EMS partners to improve identification in the prehospital environment (see Appendix DD for Project Timeline). Projected costs were estimated to be extensive over the 18-month program, but were mitigated by attaining our goals for reducing overall sepsis mortality and overall ALOS (see Appendix J for Estimated Project Budget).

A review of the hours utilized to train hospital staff identified costs that were not originally budgeted in the training costs. The ED educator, who also serves as the sepsis co-champion, bore the responsibility for all education and training for all 894 registered nurses in the facility. The original estimate of 42 classes lasting two hours each was increased to 52 classes in order to accommodate staff who were on vacation, medical leave, or who did not have the opportunity to attend one of the originally scheduled sessions. Additionally, all of the overtime for the ED nurse educator was charged to the ED budget instead of allocating the hours across the organization for the training of the staff. Another unforeseen cost came from 479 of the 894 nurses attending the training who scheduled their classes following a shift or above and beyond their normally scheduled hours, which incurred additional premium pay.

The resources required for this project primarily resulted from administrative, financial, and technical needs and support. Financial resources encompassed the largest expenditures, resulting from implementation of the training program for nurses throughout the facility, data abstraction from charts, and time associated with committee meetings from project inception

through completion in July 2016. Administrative support was crucial for engagement and accountability for sepsis improvement from all stakeholders. Technical support was instrumental for data analysis, distribution of metrics, and resources utilized during staff education throughout the project (see Appendix J for a detailed explanation of the project resources and budget).

Ongoing communication was not only essential, but it was vital to the success of this project. The following were the information flow requirements key to the project's success:

- Communication regarding barriers and progress with the Sutter Health corporate sepsis rapid process improvement work (RPIW) group meetings prescheduled for the third Thursday of each month.
- Assuring monthly metric data with total sepsis cases and morality rates were submitted to Sutter Health corporate office for inclusion into organization-wide data.
- Requirements for additional resources for training and project implementation communicated to the executive leadership team on a regular basis.
- Communication to the executive team regarding project progress and delays, monthly and as needed, through the sepsis improvement team meetings.
- Immediate communication of any changes, barriers, or constraints to the executive leadership team and advisor.

Interpretation

As a system, Sutter initially invested in training to reduce sepsis mortality in 2011. While they experienced some initial improvement, recommendations from the 2012 Surviving Sepsis Campaign warranted more education and training under the new guidelines. This new focus presented an opportunity for a macrosystems approach involving EMS in the identification and early treatment and pre-notification prior to arrival, ultimately resulting in improvement of

overall mortality and LOS. With further study, EMS involvement in the identification and treatment of the prehospital septic patient could be expanded to assessing serum lactates prior to fluid administration, potentially impacting sepsis care nationwide.

Conclusions

The literature demonstrated possibilities for improving the recognition and notification of sepsis within the prehospital environment. With recommendations from the 2012 Surviving Sepsis Campaign and an ever-increasing awareness to recognize and treat sepsis as quickly as possible by hospital ED and inpatient units, opportunities exist to involve our prehospital partners in the process. Some of the strongest evidence found demonstrating improved patient outcomes from a coordinated system of prehospital care comes from the treatment of patients experiencing an AMI or stroke (National EMS Advisory Council, 2009). Through involvement of our EMS partners in the development of prehospital protocols for the treatment of sepsis, similar to those used in the treatment and notification of AMI and stroke, we were capable of making headway in improving reductions in mortality and overall LOS.

Partnering with EMS through education and support of sepsis initiatives allowed for the ability to impact sepsis care in the prehospital environment, which led to improved utilization of EGDT and reduction of overall mortality and LOS. Guerra et al. (2012) stated that early EMS detection of patients with severe and critical disorders and advance notification to the receiving ED has been shown to decrease time to diagnosis and treatment and potentially improve outcomes. The evidence reviewed in this paper suggest that opportunities exist for the development of protocols and implementation of sepsis education for EMS partners within the prehospital care system as a means to improve recognition, initiation of EGDT, and allow for timely notification to the receiving ED.

Collaborative development of prehospital sepsis care protocols between EMS and hospital ED team members was crucial for transitions of care to remain seamless between the prehospital and acute care setting. History demonstrates that partnering with our prehospital providers improves the care and outcomes for our AMI and stroke patients. If we truly intend to improve mortality and reduce the costs for treating septicemia, improving education and involvement of prehospital providers will be crucial for continued success. Improving our organization's ability to identify patients at risk for severe sepsis or septic shock, while removing barriers to treat these patients under appropriate evidence-based guidelines, led to improved mortality outcomes and a reduction in overall ALOS for MMC.

There exist some simple innovations, which could improve prehospital personnel's ability to identify patients with sepsis complications. While not currently a common practice for EMS providers to assess temperatures for patients under their care, simply adding digital oral, tympanic, or infrared forehead thermometers to their assessment tools may assist with recognition. Another option to assist in the identification of the septic patient, one currently being utilized widely in the United Kingdom, are inexpensive point-of-care lactate detectors, allowing assessment of an initial lactate prior to fluid resuscitation. These devices, widely used by athletes to assess lactate levels during training, could provide valuable data regarding initial lactate levels; although, they are not currently approved for use by the Food and Drug Administration in the evaluation of patients with complications from sepsis. Partnering sepsis initiatives between prehospital and ED staff ensures all parties are practicing similarly and providing consistent, quality care. With the institution of simple guidelines and specific treatment protocols, prehospital team members are more capable of recognizing sepsis and initiating treatment prior to arrival at the ED.

While this project concentrated its efforts on identification of the septic patient starting in the prehospital system through the inpatient admission and discharge, there still exist opportunities to further improve mortality outcomes by partnering with skilled nursing facilities, long-term acute care centers, and the community.

Section VI. Other Information

Funding

Funding for the project resulted from hours within the hospital's budget. Each department was responsible for the costs of sending their nursing staff to the 2-hour education sessions on sepsis identification and treatment. The ED budget bore all costs associated with the education performed by the department manager and clinical educator. All seven training sessions with the Stanislaus County EMS personnel were completed on the DNP scholar's personal, unpaid time. Data abstraction by the facility EMS base nurse liaison and clinical educator was completed during normal working hours, as these data were reported monthly to the hospital executive team in addition to the facility and corporate sepsis teams. The final budget and ROI are outlined in Appendix J and Appendix S.

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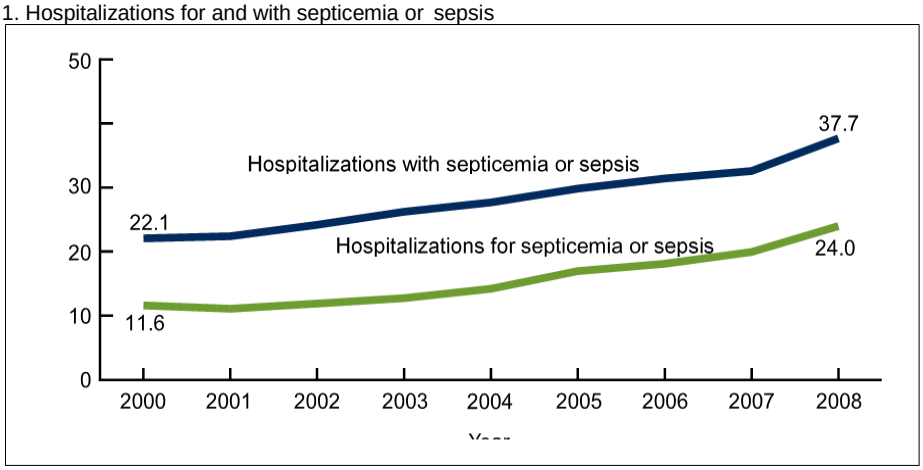
Section VIII. Appendices

Appendix A

Septicemia or Sepsis Hospitalizations: 2000 - 2008

Hospitalization rates for septicemia or sepsis more than doubled from 2000 through 2008.

Figure 1. Hospitalizations for and with septicemia or sepsis



NOTE: Significant linear trend from 2000 through 2008 for both categories. SOURCE: CDC/NCHS, National Hospital Discharge Survey, 2000–2008.

Appendix B

Facility Table

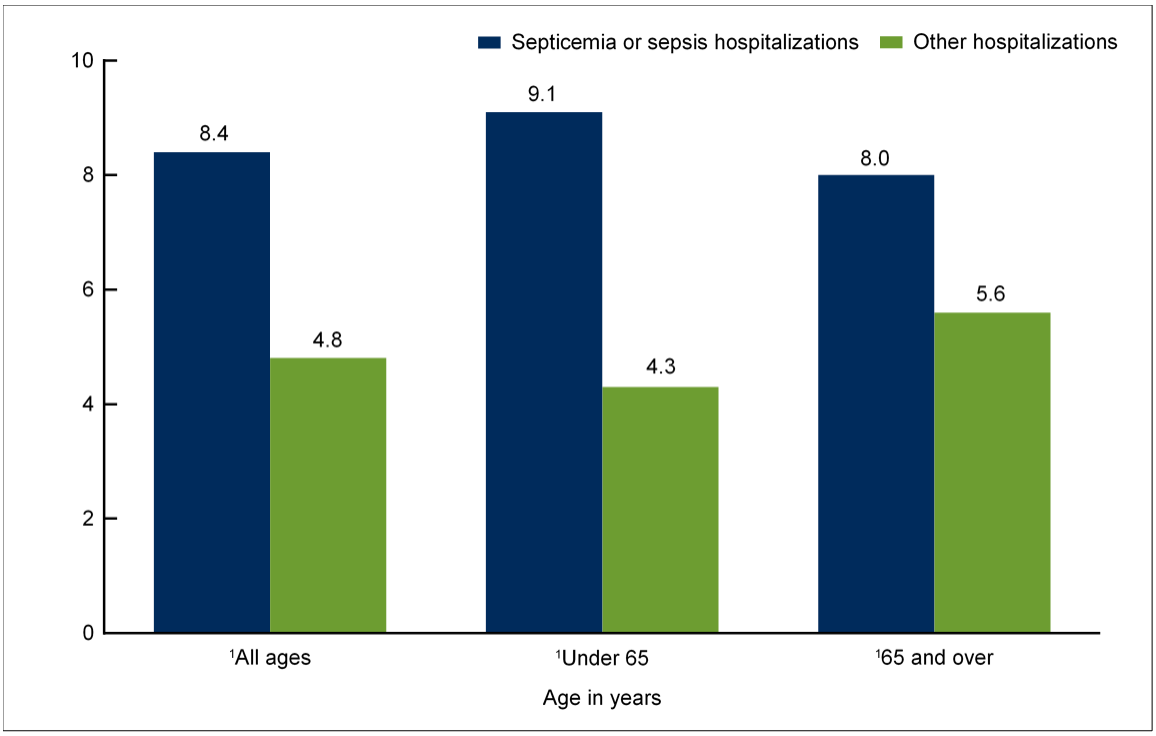
Facility Table
Feb 2014 to Jan 2015
Target=18.75 Alarm=24.93

Facility	Target Status	Numerator	Denominator	Percent
Sutter Coast Hospital		34	121	28.1%
Sutter Medical Center Sacramento		217	952	22.8%
CPMC - Pacific		171	756	22.6%
MPHS-Peninsula Medical Center		143	636	22.5%
Modesto Memorial Medical Center		208	967	21.5%
Sutter Santa Rosa Regional Hospital		39	189	20.6%
Alta Bates Ashby Campus		111	539	20.6%
Summit Medical Center Merritt		132	689	19.2%
Sutter Solano Medical Center		51	268	19.0%
Eden Medical Center		123	690	17.8%
Sutter Roseville Medical Center		112	688	16.3%
Sutter Delta Medical Center		66	429	15.4%
Sutter Davis Hospital		12	85	14.1%
CPMC - Davies		16	114	14.0%
CPMC - St. Lukes		28	201	13.9%
Novato Community Hospital		19	138	13.8%
Sutter Tracy Community Hospital		26	191	13.6%
Sutter Auburn Faith Hospital		19	163	11.7%
Sutter Amador Hospital		15	162	9.3%
Sutter Lakeside Hospital		6	66	9.1%
CPMC - Cal West		1	11	9.1%
Los Banos Memorial Hospital		5	57	8.8%
Overall		1554	8112	19.2%

Appendix C

Septicemia or Sepsis Average Length of Stay

Figure 4. Average length of stay for those hospitalized for septicemia or sepsis compared with those hospitalized for other conditions, 2008



[1]Difference is statistically significant at the 0.05 level.
SOURCE: CDC/NCHS, National Hospital Discharge Survey, 2008.

Patients hospitalized for septicemia or sepsis were more than eight times as likely to die during their hospitalization.

Appendix D

Surviving Sepsis Campaign 3- and 6-Hour Bundles

Surviving Sepsis Campaign 3-Hour Bundle

TO BE COMPLETED WITHIN 3 HOURS OF TIME OF PRESENTATION:

1. Measure lactate level
2. Obtain blood cultures prior to administration of antibiotics
3. Administer broad-spectrum antibiotics
4. Administer 30 mL/kg crystalloid for hypotension or lactate ≥4 mmol/L

Figure 6. The 3-hour Surviving Sepsis Campaign bundle: These 4 quality indicators should be accomplished during the 3-hour period after identification of severe sepsis.

Surviving Sepsis Campaign 6-Hour Bundle

TO BE COMPLETED WITHIN 6 HOURS OF TIME OF PRESENTATION:

1. Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥65 mm Hg
2. In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥4 mmol/L (36 mg/dL):
   - Measure central venous pressure*
   - Measure central venous oxygen saturation*
3. Remeasure lactate if initial lactate was elevated*

Figure 7. The 6-hour Surviving Sepsis Campaign bundle. These 3 quality indicators (number 2 is a compound indicator) are to be accomplished during the 6-hour period after identification of severe sepsis.

Appendix E

JHNEBP Non-Research Evidence Appraisal

Evidence Level:_____

ARTICLE TITLE:			NUMBER:
AUTHOR(S):			DATE:
JOURNAL:			
D Systematic Review	D Clinical Practice Guidelines	Organizational (QI, financial data)	Expert opinion, case study, literature review

Does review/expert opinion address my practice question?	Yes	No
If the answer is No, STOP here (unless there are similar characteristics).		
Systematic Review		
• Is the question clear?	Yes	No
• Are search strategies specified, and reproducible?	Yes	No
• Are search strategies appropriate to include all pertinent studies?	Yes	No
• Are criteria for inclusion and exclusion of studies specified?	Yes	No
• Are details of included studies (design, methods, analysis) presented?	Yes	No
• Are methodological limitations disclosed?	Yes	No
• Are the variables in the studies reviewed similar, so that studies can be combined?	Yes	No
Clinical Practice Guidelines		
Were appropriate stakeholders involved in the development of this guideline?	Yes	No
Are groups to which guidelines apply and do not apply clearly stated?	Yes	No
Have potential biases been eliminated?	Yes	No
Were guidelines valid (reproducible search, expert consensus, independent current, and level of supporting evidence identified for each recommendation)?	Yes	No
Are recommendations clear?	Yes	No
Organizational Experience		
Was the aim of the project clearly stated?	Yes	No
Is the setting similar to setting of interest?	Yes	No
Was the method adequately described?	Yes	No
Were measures identified?	Yes	No
Were results adequately described?	Yes	No
Was interpretation clear and appropriate?	Yes	No
Individual expert opinion, case study, literature review		
Was evidence based on the opinion of an individual?	Yes	No
Is the individual and expert on the topic?	Yes	No
Is author's opinion based on scientific evidence?	Yes	No
Is the author's opinion clearly stated?	Yes	No
Are potential biases acknowledged?	Yes	No
PERTINENT CONCLUSIONS AND RECOMMENDATIONS		
Were conclusions based on the evidence presented?	Yes	No
Will the results help me in caring for my patients?	Yes	No

Quality Rating (scale on back):

Basic quality rating of the study under review (check one)	⌋ High (A)	⌋ Good (B)	⌋ Low/major flaws(C)

STRENGTH OF EVIDENCE

LEVEL 4

SYSTEMATIC REVIEW

- Research review that compiles and summarize evidence from research studies related to a specific clinical question
- Employs comprehensive search strategies and rigorous appraisal methods
- Contains an evaluation of strengths and limitations of studies under review

CLINICAL PRACTICE GUIDELINES

- Research and experiential evidence review that systematically develops statements that are meant to guide decision-making for specific clinical circumstances
- Evidence is appraised and synthesized from three basic sources: scientific findings, clinician expertise, and patient preferences.

LEVEL 5

ORGANIZATIONAL

- Review of quality improvement studies and financial analysis reports
- Evidence is appraised and synthesized from two basic sources: internal reports and external published reports.

EXPERT OPINION, CASE STUDY, LITERATURE REVIEW

- Opinion of a nationally recognized expert based on non-research evidence (includes case studies, literature review, or personal experience).

QUALITY RATING (SUMMATIVE REVIEWS)

A High quality: well-defined, reproducible search strategies; consistent results with sufficient numbers of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies, and definitive conclusions

B Good quality: reasonably thorough and appropriate search; reasonably consistent results, sufficient numbers of well-designed studies, evaluation of strengths and limitations of included studies, with fairly definitive results

C Low quality or major flaws: undefined, poorly defined, or limited search strategies; insufficient evidence with inconsistent results, conclusions cannot be drawn

QUALITY RATING (EXPERT OPINION)

A High quality: expertise is clearly evident.

B Good quality: expertise appears to be credible.

C Low quality or major flaws: expertise is not discernable or is dubious.

Appendix F

Statement of Determination

Student Name: Scott D. Baker MSN, RN, CNL, CEN, NEA-BC

Title of Project: Reducing Mortality from Severe Sepsis and Septic Shock: A Marcosystem Approach.

Brief Description of Project: An evidence-based practice change project which seeks to reduce overall mortality from severe sepsis and septic shock in all patients presenting for care at Sutter Memorial Medical Center. This project seeks to reduce mortality to below 17 percent by August 1st 2016, through partnership and education with Mountain Valley Emergency Medical Services Agency Paramedics and hospital outpatient and inpatient registered nurses to better screen for and recognize those patients with potential or actual sepsis complications, allowing for timely initiation of early-goal directed therapy under the 2012 Surviving Sepsis Campaigns recommendations for treatment.

A) Aim Statement: In order to improve the quality and safety of care and reduce overall mortality for patients presenting with or developing severe sepsis or septic shock, we aim to improve the initial and subsequent SIRS screening for sepsis and improve the time for initiation of early goal-directed therapy. We seek to partner with the pre-hospital system and our facilities out-patient and in-patient units in order to educate and empower care providers towards early interventions to reduce complications from unrecognized severe sepsis or septic shock. Our goals are to reduce overall facility wide mortality from 21.9% to less than 18%, reduce ALOS for admitted patients by at least one day.

B) Description of Intervention: Through education and engagement, improve recognition of the patient who meets SIRS criteria within the pre-hospital and hospital environment improving use of early treatment guidelines to initiate timely blood cultures and lactate measurement along with fluid resuscitation and antibiotic therapy in an effort to reduce overall mortality related to severe sepsis and septic shock.

C) How will this intervention change practice? Early screening and recognition are key to reducing mortality from severe sepsis and septic shock. Through education and partnerships with EMS we hope to improve our ability to recognize sepsis and initiate treatment starting in the pre-hospital environment through discharge from the facility. With proper education and empowerment of EMS personnel and Nurses to identify the early warning signs of sepsis and quickly intervene, we expect to save lives and achieve a 4.9 percent reduction in our overall mortality rates.

D) Outcome measurements:

- Reduction in monthly mortality data to achieve an overall reduction in mortality

from 21.9 percent to less than 17 percent by August 1st, 2016. We will monitor and report mortality data monthly on severe sepsis, septic shock and combined data.

- Sepsis bundle compliance utilization rate increase from 30% currently to above 75% by August 1st, 2016. Data will be abstracted monthly through chart review and reported in executive team meetings and sepsis committee meetings.

- Reduction in the Average Length of Stay for patients who meet severe sepsis or septic shock criteria by at least one day overall by August 1st, 2016. Data will be collected from the MMC Finance department on pre-project and post project length of stay data with regards to DRG's 870, 871 & 872.

To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used: (http://answers.hhs.gov/ohrp/categories/1569)

☐ This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). Student may proceed with implementation.

☐This project involves research with human subjects and must be submitted for IRB approval before project activity can commence.

Comments:

EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

Instructions: Answer YES or NO to each of the following statements:

Project Title: Reducing mortality from severe sepsis and septic shock through engagement and education of early recognition and treatment for pre-hospital and hospital personnel.	**YES**	**NO**
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.	**X**	
The specific aim is to improve performance on a specific service or program and **is a part of usual care**. ALL participants will receive standard of care.	**X**	
The project is **NOT** designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does **NOT** follow a protocol that overrides clinical decision-making.	**X**	
The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The	**X**	

project does **NOT** develop paradigms or untested methods or new untested standards.		
The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does **NOT** seek to test an intervention that is beyond current science and experience.	**X**	
The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.	**X**	
The project has **NO** funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.	**X**	
The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., **not** a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.	**X**	
If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: "*This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board."*	**X**	

ANSWER KEY: If the answer to **ALL** of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. **IRB review is not required. Keep a copy of this checklist in your files.** If the answer to ANY of these questions is **NO**, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

STUDENT NAME (Please print): Scott D. Baker MSN, RN, CNL, CEN, NEA-BC

Signature of Student:

_____DATE: 7/22/2015

SUPERVISING FACULTY MEMBER (CHAIR) NAME (Please print):

Dr. Juli Maxworthy DNP, MSN, MBA, RN, CNL, CPHQ, CPPS, CHSE

Signature of Supervising Faculty Member (Chair):

_____DATE_____

Appendix G

Survey

1. Which of the following is the definition of Sepsis?

- ◯ Allergy
- ◯ Suspicion or presence of an infection
- ◯ Suspicion or presence of infection with inflammatory response
- ◯ An infection that interrupts the blood flow to the brain or kidneys leading to organ failure

- Which of the following is the definition of Septic Shock?

- ◯ When an infection reaches the blood stream and causes inflammation throughout the body.
- ◯ When infection disrupts the blood flow to the brain or kidneys leading to organ failure.
- ◯ A diagnosis of sepsis and a blood pressure that drops significantly low.
- ◯ An individual experiences organ failure following an electrical shock.

- What does SIRS stand for?

- ◯ Systemic Inflammatory Response Syndrome.
- ◯ Symptomatic Initial Response of Sepsis.
- ◯ Systemic Infection Resulting from Surgery.
- ◯ Symptoms Indicating Respiratory Suppression.

- Sepsis syndrome is the most expensive condition treated in U.S. Hospitals?

- ◯ True.
- ◯ False.

- Sepsis accounts for how many deaths worldwide every day?

- ◯ 14,000

- 140
- 1,400

- Research indicates that left untreated, mortality in septic shock rises by what % per hour?

- 50%
- 25%
- 8%
- 1%

- In order to meet SIRS criteria, an individual must meet how many of the following indicators?

Heart Rate > 90
RR > 20
SBP < 90
Temp > 100.4 or < 96.8
Increased or decreased WBC count

- 3
- 4
- 1
- 2

- One of the lab values measured that could indicate a diagnosis of severe sepsis is?

- Red Blood Cells (RBC's)
- Sodium Level
- Lactic Acid
- Hematocrit

- Of the following interventions, which is the most important in reducing mortality from severe sepsis and septic shock?

- Early IV access & Early Blood Cultures.
- Early Fluid Administration & Early Broad Spectrum Antibiotics.
- Early Oxygenation & Early Tylenol Administration.

Early Pulse Oximetry & Early Temperature Identification.

- Which gender and race are more as risk for developing sepsis?

◯ Women & Caucasians

◯ Men & African Americans.

◯ Women & African Americans.

◯ Men & Caucasians.

- Data suggest that patients in low income populations or those with lower educational level have a tendency towards higher 1-year mortality rates:

◯ True

◯ False

- Early recognition of sepsis by pre-hospital providers has resulted in:

◯ Increased patient mortality.

◯ Improved times to IV fluid and antibiotic administration.

◯ Decreased times to IV fluid and antibiotic administration.

◯ Decreased patient mortality.

Appendix H

ED Staff Sepsis Screening FAQs

1. **What is the criterion for calling a Sepsis Alert?**
    a. Patient is newly positive to questions 1, 2, & 3 on the sepsis screen
        i. Infection suspected, 2 SIRS, and risk factors

    OR

    b. Patient is newly positive to question 1 & 4 on the sepsis screen
        i. Infection suspected and organ dysfunction

    *For inpatient units, RRT validates the positive screen and then calls a Sepsis Alert.

2. **What is the criterion for calling a Code Sepsis?**
    a. Code Sepsis is activated when a severe sepsis patient remains hypotensive despite fluid resuscitation (30ml/kg) or the lactate is > 3.9 mmol/L.

3. **What is the difference between Sepsis Alert and Code Sepsis?**
    a. A Sepsis Alert identifies a patient with possible severe sepsis and the goal is that the 3-hour sepsis bundle would be initiated
    b. A Code Sepsis identifies a patient with possible septic shock and the goal is that the 6-hour sepsis bundle would be initiated

4. **You just got a patient from the ED or are screening a patient for your shift and the patient screens positive for sepsis. The ED or prior shift did not call a Sepsis Alert on the patient. Do you automatically have to call RRT (and then Sepsis Alert) because the ED or prior shift didn't call it?**
    a. Not necessarily. If the correct treatment occurred (3-hour bundle) and the patient is stable with improving symptoms, you could choose "Currently being treated for severe sepsis" on question 5 on the screen. If the correct treatment did not occur or the patient's symptoms are worsening or new, you would choose "yes" on question 5 and call RRT (and then possibly Sepsis Alert when RRT validates).

5. **My trauma patient just came from the OR and screens positive for high risk of severe sepsis. I called the physician and they don't want to treat it as sepsis. Why?**
    a. Trauma patients are known to develop SIRS (Systemic Inflammatory Response Syndrome) for non-infectious reasons so 2 SIRS criteria may be a "normal" finding in this group of patients especially within 24 to 48 hours of arrival.

6. **My patient screened negative earlier in my shift but I just got a BPA for an elevated lactate and elevated creatinine. What do I do now?**

a. First acknowledge the BPA by choosing an action (ideally "will screen/rescreen my patient" if appropriate) and then click "accept"
b. Rescreen your patient and determine if they are newly positive to 1,2&3 or 1&4
    i. If yes, call RRT to validate screen and determine if sepsis alert will be called

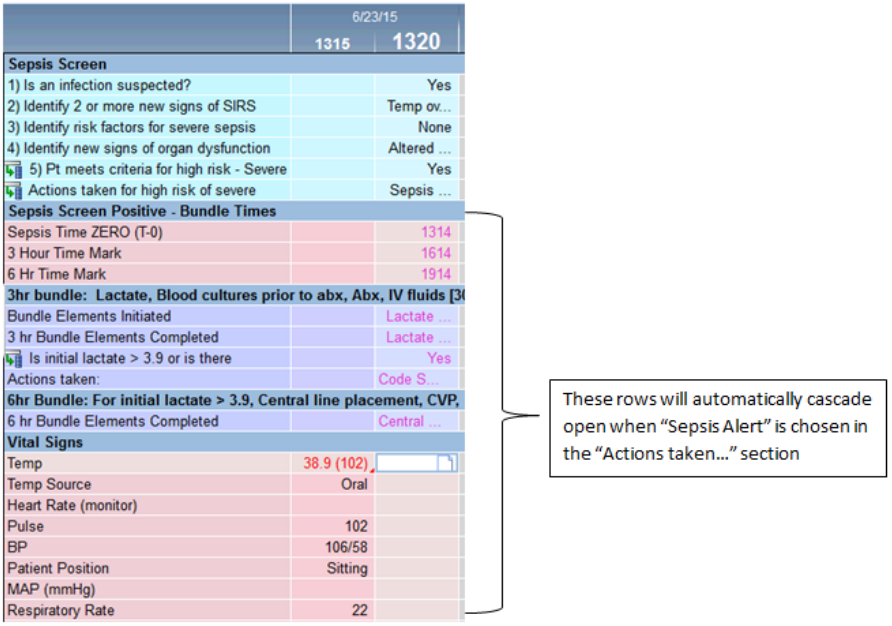
7. **You are working in ED and your initial sepsis screen was negative for your patient (suspected infection – yes; 1 SIRS, no risk factors, no organ dysfunction). Your WBC's come back at 18,000 and lactate is 2.1 so the patient would now screen positive. The patient has already had blood cultures drawn, lactate, and broad-spectrum antibiotics started (didn't require fluids). Do you still have to call a Sepsis Alert?**
    a. Not necessarily. A Sepsis Alert does not have to be called if everything in the 3-hr bundle is complete. However, be sure to rescreen the patient with the new information and include the 3-hr bundle treatment that has been completed so this information is available for the admitting unit.

8. **You have called a RRT call for your patient who screened positive for high risk of severe sepsis. The physician and RRT RN respond to the patient. The RRT RN confirms the positive screen but the physician states that he doesn't want a Sepsis Alert called. What do you do?**
    a. First thing to do is to clarify why the physician doesn't want the alert called. Some reasons may include:
        i. They don't feel that the patient symptoms/+ screen is related to sepsis/severe sepsis
            - If this is the case, it is appropriate to adhere to physician discretion
        ii. They don't want it called because "everything is already being done"
            - If everything in the 3-hr bundle <u>has</u> been addressed, then it would be appropriate to not call the Sepsis Alert. Be sure to document the bundle elements that are ordered and completed and ensure that they are done within 3 hours of the positive screen.
        iii. They don't want to call it because they are at the bedside - "I'm right here"
            - In this case, clarify that the Sepsis Alert process brings additional resources and alerts the entire team so that the time-sensitive treatments/diagnostics can be accomplished quickly and efficiently. If they still don't want the Sepsis Alert called, do not call it but continue to ensure that the appropriate treatment is implemented and documented.

9. **Does Lab/Phlebotomy and Radiology have to respond to a Code Sepsis?**
    a. No. Phlebotomy responds to ED and Inpatient Sepsis Alerts since lactate and blood cultures are part of the standard work. Radiology responds to ED Sepsis Alerts for initial CXR if required ("alerted" for Inpatient Sepsis Alert).

10. **Do all 'shortness of breath' complaints require that we choose "Yes" to "Infection Suspected" (question 1) on the on the sepsis screen?**
    a. Not necessarily. Screening this patient requires some clinical judgment. If the patient has a history of COPD and it appears that this is a typical flare for this patient and they don't give you information that supports a possible infection (i.e. productive cough and history of fever), you could choose "No" to "suspected infection". A patient with history of asthma who appears to be having asthma exacerbation would also be appropriate to choose "no" to "suspected infection".

11. **I've documented the severe sepsis treatment that my patient has received in the MAR, flow sheets, and notes. Why should I also include this information in the sepsis rows/sepsis summary?**
    a. When you document the time zero, 3hr, and 6hr times and bundle information in the sepsis summary, it makes the information easy to find for the next person caring for the patient. Everyone who is in the chart will know what the time goals are and the information from the sepsis summary populates the "Sepsis Overview" report in EPIC. The Sepsis Overview report is a screenshot of pertinent VS, labs, meds, time goals, and sepsis treatment.



Appendix I

Review of the Evidence Table

Authors	Purpose/Design	Sample & Setting	Synthesis & Major Findings	Level of Evidence
Studnek et al. (2010)	Purpose: To Determine if ER patients with severe sepsis who arrived by emergency medical services received faster recognition and treatment (time to antibiotics) as compared to walk-in patients. Also among EMS transported patients, did recognition of sepsis in the field result in differential time to early goal-directed therapy compared to patients in which sepsis was not recognized in the field. Design: Prospective observational study.	311 patients from an urban 800-bed teaching hospital with 100,000 + visits annually.	160 (51.4%) of the 311 patients in the study were transported by EMS. Patients arriving by EMS had shorter time to first antibiotics (111 minutes' v/s 146 minutes) and shorter time from triage to initiation of EGDT (119 minutes' v/s 160 minutes), compared to patients who did not arrive by EMS. For all patients arriving by EMS, if the paramedic recognized sepsis in the field, there was a shorter time to antibiotics (70 min v/s 122 min) and a shorter time to EGDT (69 min v/s 131 min) compared to those in which there was no prehospital recognition of sepsis.	Level IV Quality Rating B
Fleming et al. (2014)	Purpose: To determine whether there was a difference in treatment outcomes for sepsis between patients presenting directly to the ED v/s those arriving by EMS. The aim of the study was to determine if there was a difference in outcome (mortality) between patients who arrived by EMS versus those who arrived by walk-in presentation. Design: Retrospective review of prospectively collected data.	All septic patients presenting to an inner-city tertiary care major trauma center who had been admitted to the medical intensive care unit from the ED between 11/2009 and 3/2012. 485 total patients were included in the study, 378 which had arrived by EMS and 107 who walked into the ED.	Patients arriving by EMS were older than walk-in patients (59 years compared to 52 years), presented with increased altered mental status (57% v/s 32%) and were more likely to be triaged to the highest level of care (78% v/s 64%) than the walk-in. Patients arriving by EMS had faster time to antibiotics and central line placement. Both groups had equal mortality and hospital LOS although patients given large volume fluid resuscitation in the field had no mortality improvement but did experience shorter LOS (5 days' v/s 10 days) for those who survived.	Level IV Quality Rating B

Seymour et al. (2012)	Purpose: To examine the epidemiology of prehospital severe sepsis among EMS encounters, relative to acute myocardial infarction (AMI) and stroke. Design: Retrospective Cohort Study.	All EMS visits in King County, Washington, not including the city of Seattle. Of the 407,176 total EMS visits between 2000 and 2009, the authors identified 13,249 hospitalizations for severe sepsis of which 2,596 (19.6%) resulted in a mortality.	Crude incidence rate for severe sepsis was 3.3 per 100 EMS arrivals, greater than AMI at 2.3 per 100 and Stroke at 2.2 per 100. EMS visits hospitalized for severe sepsis, more than half met SIRS criteria for heart rate (58%) and respiratory rate (50%) upon scene arrival. On average, EMS provided on-scene care for 35 minutes, including a mean 43 minutes when paramedics were on scene. Many encounters experienced scene times >50 minutes, yet average transport time was 12.6 minutes. The majority of severe sepsis cases transported by EMS (80%) were diagnosed on admission, not in the field. Findings suggest opportunities to recognize and potentially treat severe sepsis before hospital arrival.	Level IV Quality Rating A
Band et al. (2011)	Purpose: To evaluate the effect of arrival to the ED by EMS regarding time to antibiotics, time to initiation of IV fluid resuscitation and in-hospital mortality for patients with severe sepsis or septic shock. Design: Secondary analysis of prospectively collected registry data.	963 adult patients diagnosed with severe sepsis or septic shock who were admitted from University of Pennsylvania's ED, an urban, tertiary care, academic medical center with an annual census of greater than 60,000 adult patients, over 2 years; January 1, 2005 to December 31, 2006.	Median time to antibiotics was 116 minutes' v/s 152 minutes for non-EMS patients, with initiation of IV fluids 34 minutes for EMS and 68 minutes for non-EMS. The study used sepsis registry data to compare ED processes and outcomes for patients who arrive by EMS to those who arrived by other means. The authors found that arrival by EMS was associated with significantly decreased time to initiation of IV fluids and antibiotics, however, they found no difference in hospital mortality between EMS and non-EMS patients.	Level IV Quality Rating A

Wang et al. (2009)	Purpose: To look at the differences related to EMS's identification and treatment of critical illness such as Trauma, myocardial infarction and stroke as compared to sepsis. Design: Prospective observational study.	The authors sampled 4613 patients presenting with serious infections to an urban academic ER who received admission to the hospital for treatment of the infection.	1576 (34.2%) received initial EMS care with a mortality rate among those transported by EMS being 126/1576 (8%) compared to 67/3037 (2.2%) in those who were not transported by EMS although they found that EMS patients were more likely to present with organ dysfunction and nearly four times more likely to present with severe sepsis or septic shock. In this study, EMS provided care to over one third of ED patients with infection, including the majority of patients with severe sepsis and septic shock and may benefit from education and protocols for advancing sepsis diagnosis and care.	Level IV Quality Rating A
Guerra et al. (2012)	Purpose: To determine the feasibility of EMS providers to recognize severe sepsis in patients they transport through implementation of a sepsis alert protocol, thereby resulting in improved outcomes if EGDT was initiated earlier. Design: Retrospective case control study.	Three tertiary care centers in Colorado, who collectively care for greater than 80,000 patients annually. 15,338 EMS patients presented to the three participating ED's during the study time frame and of these 1069 were identified as having infections. Application of their Level 1 and Level 2 screening tools identified 112 EMS patients, transported to all three ED's in severe sepsis.	During the study time of 2009, trained EMS providers transported 67 of 112 EMS patients in severe sepsis. Trained EMS providers recognized 32 (47%) of severe sepsis patients and activated the sepsis alert protocol. They failed to identify 35 of the 67 patients for severe sepsis upon hospital arrival. Overall mortality was 26.7% (30 of 112). Mortality for the sample of severe sepsis patients who had the sepsis alert protocol initiated was 13.6% (5 of 37)	Level IV Quality Rating B

Carlbom & Rubenfeld (2007)	Purpose: To assess written protocol barriers to implementation for EGDT for severe sepsis in busy Emergency Departments. Design: Telephonic Survey Questionnaire with both qualitative and quantitative analysis.	Two of the busiest teaching and two busiest non-teaching emergency departments in 25 most statistically and densely populated areas of the U.S. 24 physicians and 40 nurse managers representing 53% of the 100 hospitals surveyed.	Nurse managers and ED physicians identified multiple barriers to implementing time-sensitive resuscitation to patients with severe sepsis. More than half of all respondents recognized a critical shortage of nursing staff, problems in obtaining central venous pressure monitoring, and challenges in identification of patients with sepsis as the largest roadblocks to overcome in implementing early goal-directed therapy.	Level IV Quality Rating A
Cronshaw et al. (2011)	Purpose: To assess the recognition and management of patients presenting with SS/SS across three emergency departments (EDs) within the West Midlands. Design: Retrospective Review	Data collected from three emergency departments over a 3-month period. Patients in the ED with a diagnostic code of, or presenting complaint suggestive of, sepsis, had their scanned notes assessed for evidence of SS/SS. Compliance with the CEM guidelines, and evidence of referral to the intensive care staff was evaluated.	255 patients with SS/SS were identified. Of these, 17% (44/255) were documented as septic by ED staff. The CEM standard of care was received in 41% of those with a documented diagnosis of severe sepsis in the ED, and 23% of patients with SS/SS overall. 89% of patients received the 'treatment' aspects of care: oxygen, IV antibiotics and IV fluids. Twelve patients with a raised lactate level and normal blood pressure (cryptic shock) failed to receive fluid resuscitation. 71% of patients with SS/SS had no documented discussion or consideration of referral to the intensive care unit.	Level IV Quality Rating B

MacRedmond et al. (2010)	Purpose: To investigate the effectiveness of a comprehensive management protocol for recognition and initial treatment of severe sepsis that spans from the emergency department (ED) to the intensive care unit. Design:	Single hospital study with a total of 74 study participants. 37 patients who had severe sepsis were identified in the ED were compared to a randomly selected group of 37 patients who had severe sepsis and who were transferred directly to the intensive care unit.	Significant improvements were observed in mean time to initiation of early goal-directed therapy and to achievement of resuscitation goals. There was a trend towards more rapid administration of antibiotics. This was associated with a decrease in crude hospital mortality rate from 51.4% to 27.0% (absolute risk reduction=24%, 95% CI 3% to 47%). Improvements were sustained in the follow-up audit at 16 months.	Level IV Quality Rating B

Appendix J

Estimate Project Budget and Resources

Memorial Medical Center
Estimated Project Budget & Resources
Jul 2015 – June 2016

Initiative	Unit Cost	Quantity	Total
Bi-Monthly 2-Hour Sepsis Team Committee Meetings	$65.00 average per hour	24 meetings/14 team members/	$21,840.00
Sutter Health Sepsis Implementation Workshop	$65.00/Average per hour	40 staff/6-hour training	$15,600.00
Administrative Hours	$80.00/hour	18 months/4 hours per month/72 hours	$5,760.00
Two Hour Sepsis Education/Training for all hospital RN's. 42 initial training classes/12 additional monthly classes from June 15 – July 16 for new hires	$65.00/Average per hour	1120 RN's (including new hires through June 2016) 579 RN's incurred premium pay during initial training sessions (see breakdown below)	$72,800.00
Additional costs for ED Educator to conduct training	$32.75/hour overtime $65.00/hour double time (All 42 training sessions resulted in OT & DT	428 staff attended in Overtime 151 staff attended in Double time	$14,017.00 $9,815.00
Costs for ED Educator to conduct hospital wide training sessions	$65.50/hour	54 classes/2 hours each	$7,074.00
Additional ED Educator class prep time and set-up (30 minutes per class)	$32.75/hour (overtime)	52 classes	$1,703.00
Additional make-up classes scheduled to accommodate staff on vacation, FMLA, or those unable to attend the initial training	$65.50/hour Educator	10/two-hour classes 10/classes with 30-minute set-up time	$1,310.00 $327.50.00
EMS Personnel Training conducted	$144.34/hour total salary	Six 30-minute presentations	$433.29.00

by ED Manager and EMS Base Nurse Liaison			
Stanislaus County EMS Symposium presentation conducted by ED Manager & EMS Base Nurse Liaison	$144.34/hour total salary	One 60-minute presentation	$144.34.00
Total Costs of Program			$150,824.13

Appendix K

EMS and ER Walk-in Sepsis Volume: 2014 - 2016

Memorial Medical Center Emergency Department
EMS & ER Walk-In Sepsis Volume
2014 – 2016

Description	**2014**	**2015**	**2016 (Ann. April)**	**% Chg. (14 vs. 16)**
Emergency Department Walk-In Presentation	447	472	475	1.1%
Emergency Medical Services Presentation	509	519	523	1.1%
Total Volume	956	991	998	1.0%

*2016 Data – Annualized with YTD April data
Source: CVR Quality Department, Monthly Reports, 2013-2015

Appendix L

Pre-Project Estimated ROI

Memorial Medical Center

Pre-Project Estimated ROI based on anticipated reduction in LOS

Jul 2014 – June 2015

Month/Year	Estimated one-day Reduction in stay per patient per month	Patient Total Day's per Month	*Average Daily Cost by DRG's 870, 871 & 872	Potential Cost Avoidance for care of Sepsis July 2014 – Feb 2015
Jul – 2014	1 day per pt./ 74 patients	**678.6**	$1900.00	$ 140,600.00
Aug –2014	1 day per pt./ 81 patients	**722.5**	$1900.00	$ 153,900.00
Sep – 2014	1 day per pt./ 82 patients	**757.1**	$1900.00	$ 155,800.00
Oct – 2014	1 day per pt./ 85 patients	**870.3**	$1900.00	$ 161,500.00
Nov –2014	1 day per pt./ 79 patients	**773.4**	$1900.00	$ 150,100.00
Dec –2014	1 day per pt./ 98 patients	**1069.6**	$1900.00	$ 186,200.00
Jan – 2015	1 day per pt./ 95 patients	**981.1**	$1900.00	$ 180,500.00
Feb –2015	1 day per pt./ 85 patients	**837.8**	$1900.00	$ 161,500.00
Mar –2015	1 day per pt./ 94 patients	**854.2**	$1900.00	$ 178,600.00
Apr –2015	1 day per pt./ 75 patients	**652.1**	$1900.00	$ 142,500.00
May –2015	1 day per pt./ 76 patients	**649.1**	$1900.00	$ 144,400.00
Jun –2015	1 day per pt./ 75 patients	**608.1**	$1900.00	$ 142,500.00
	999 patients	**9453.9**		**$ 1,898,100.00**

* Average Daily Cost's for DRG's 870, 871 & 872 are based on the entire inpatient stay including ancillary services Source: MMC Finance Department, Monthly Reports, July 2014 – June 2015

Appendix M

Total Sepsis Patients Admitted by Department

Memorial Medical Center
Total Sepsis Patients Admitted by Department
July 2015 – Jun 2016

Month/Year	Surgical	Renal Tele	Cardiac Tele	Intensive Care Unit	Total Patients per Month
Jul 2015	7	41	27	21	96
Aug 2015	9	39	26	19	93
Sep 2015	3	32	26	21	82
Oct 2015	3	39	29	21	92
Nov 2015	9	32	22	16	79
Dec 2015	10	45	42	12	109
Jan 2016	5	41	29	27	102
Feb 2016	8	34	31	22	95
Mar 2016	5	39	28	32	104
Apr 2016	4	42	25	30	101
May 2016	8	39	22	29	98
Jun 2016	4	37	24	25	90
Totals	75	460	331	275	1141

Source: MMC Finance Department, Monthly Reports, Jul 2015 – June 2016

Appendix N

Total Sepsis ALOS by Department

Memorial Medical Center
Total Sepsis ALOS by Department
Jul 2015 – Jun 2016

Month/Year	Surgical	Renal Tele	Cardiac Tele	Intensive Care Unit
Jul 2015	10.8	9.1	9.0	6.5
Aug 2015	9.5	8.8	8.3	6.6
Sep 2015	5.7	9.4	11.5	6.9
Oct 2015	12.8	9.4	13.1	4.3
Nov 2015	9.2	8.7	9.4	10.9
Dec 2015	10.8	11.0	9.8	10.1
Jan 2016	11.3	8.9	11.4	10.3
Feb 2016	9.2	8.3	9.4	10.7
Mar 2016	8.8	8.1	9.1	8.1
Apr 2016	7.3	8.0	8.8	7.9
May 2016	7.8	7.9	9.2	7.7
Jun 2016	7.6	7.7	8.8	7.1
ALOS by Department	9.3	8.8	9.8	8.1

Source: MMC Finance Department, Monthly Reports, Jul 2015 – June 2016

Appendix O

Total Patient Days Related to Sepsis Complications

Memorial Medical Center
Total Days (= Patient Counts X ALOS)
Jul 2015 – Jun 2016

Month/Year	Surgical	Renal Tele	Cardiac Tele	Intensive Care Unit	Total Day's by Month
Jul 2015	75.6	373.1	243.0	136.5	**828.2**
Aug 2015	85.5	296.4	189.8	125.4	**697.1**
Sep 2015	17.1	195.2	299.0	144.9	**656.2**
Oct 2015	38.4	319.6	379.9	86.1	**824.0**
Nov 2015	82.8	278.4	162.8	174.4	**698.4**
Dec 2015	108.0	495.0	373.8	85.2	**1062.0**
Jan 2016	56.5	364.9	330.6	278.1	**1030.1**
Feb 2016	73.6	248.2	291.4	213.4	**826.6**
Mar 2016	44.0	315.9	254.8	230.4	**845.1**
Apr 2016	29.6	302.4	220.0	228.0	**780.0**
May 2016	60.0	269.1	202.4	200.1	**731.6**
Jun 2016	28.4	262.7	196.8	177.5	**665.4**
Total Day's by Unit	**699.5**	**3720.9**	**3144.3**	**2080.0**	**9644.7**

Source: MMC Finance Department, Monthly Reports, Jul 2015– June 2016

Appendix P

Monthly Costs of Care for Sepsis Patients

Memorial Medical Center
Total Costs of Care for Sepsis Patients by Month
Jul 2015 – Jun 2016

Month/Year	Total Day's by Month	*Average Daily Cost by DRG's 870, 871 & 872	Total Cost of care for Sepsis by month for July 2015 – Feb 2016
Jul 2015	**828.2**	$1900.00	$1,573,580.00
Aug 2015	**697.1**	$1900.00	$1,324,490.00
Sep 2015	**656.2**	$1900.00	$1,246,780.00
Oct 2015	**824.0**	$1900.00	$1,565,600.00
Nov 2015	**698.4**	$1900.00	$1,326,960.00
Dec 2015	**1062.0**	$1900.00	$2,017,800.00
Jan 2016	**1030.1**	$1900.00	$1,957,190.00
Feb 2016	**826.6**	$1900.00	$1,570,540.00
Mar 2016	**845.1**	$1900.00	$1,605,690.00
Apr 2016	**780.0**	$1900.00	$1,482,000.00
May 2016	**731.6**	$1900.00	$1,390,040.00
Jun 2016	**665.4**	$1900.00	$1,264,260.00
	9644.7		**$ 18,324,930.00**

* Average Daily Cost's for DRG's 870, 871 & 872 are based on the entire inpatient stay including ancillary services
Source: MMC Finance Department, Monthly Reports, Jul 2015 – Feb 2016

Appendix Q

Pre- and Post-Project Total Days and ALOS

Memorial Medical Center
Total Days & ALOS Pre & Post Project
Jul 2014 – June 2016

Data Pre-Project July 2014 – June 2015	**Surgical**	**Renal Tele**	**Cardiac Tele**	**Intensive Care Unit**	**Totals**
Total Patients July 2014 – June 2015	91	376	281	251	999
ALOS July 2014 – June 2015	9.5	9.3	10.2	8.5	
Data Post-Project July 2015 – June 2016	**Surgical**	**Renal Tele**	**Cardiac Tele**	**Intensive Care Unit**	
Total Patients July 2015 – June 2016	75	460	331	275	1141
ALOS July 2015 – June 2016	9.3	8.8	9.8	8.1	
Reduction in ALOS Pre & Post Project Implementation	**Surgical**	**Renal Tele**	**Cardiac Tele**	**Intensive Care Unit**	
Total Reduction in ALOS by Dept.	0.2	0.5	0.4	0.4	

Source: MMC Finance Department, Monthly Reports, Jul 2014 – June 2016

Appendix R

Post-Project Cost Avoidance from ALOS Reduction

Memorial Medical Center
Cost Avoidance from ALOS reduction Post Project
Jul 2015 – June 2016

Department	Surgical	Renal Telemetry	Cardiac Telemetry	Intensive Care Unit	Total Cost Avoidance
Total Reduction in ALOS by Dept.	0.2 days	0.5 days	0.4 days	0.4 days	
Total Project Sepsis Patients by Dept.	75	460	331	275	
Average Daily Cost Associated with DRG's 870, 871 & 872	$1900.00	$1900.00	$1900.00	$1900.00	
Total ALOS Cost Avoidance by Dept.	$28,500.00	$437,000.00	$251,560.00	$209,000.00	**$926,060.00**

Total ALOS Cost Avoidance = (Reduction in ALOS) (Total Patients) (Average Daily Costs)

Appendix S

Return on Investment/Cost Benefit Analysis

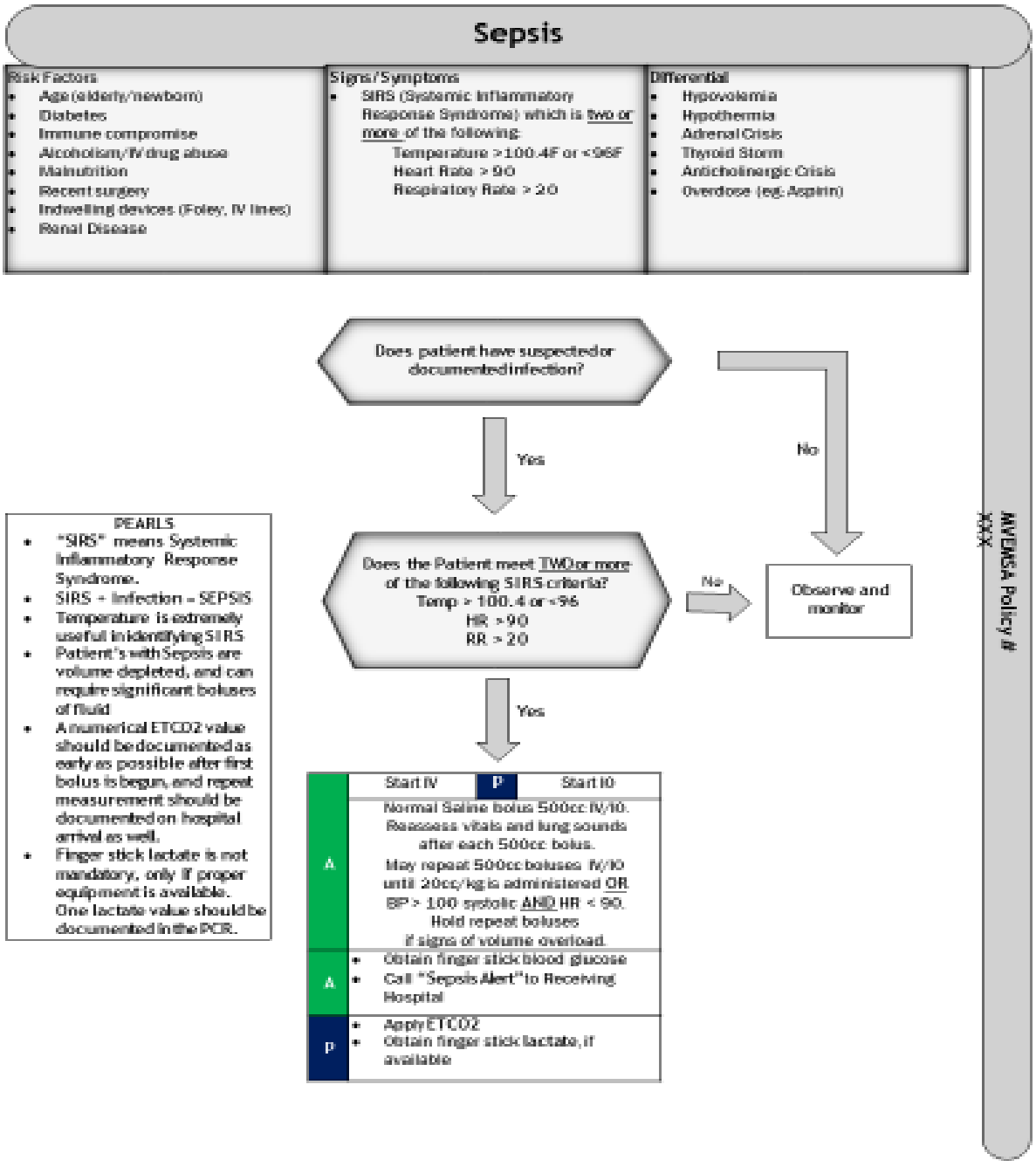
Memorial Medical Center
Jul 2015 – June 2016

Sepsis Project Return on Investment		
Total ALOS Cost Avoidance	**Total Investment**	**ROI**
$926,060.00	**$150,824.13**	**$775,235.87**

ROI = Total ALOS Cost Avoidance – Total Initial Investment

Appendix T

EMS Sepsis Treatment Protocols



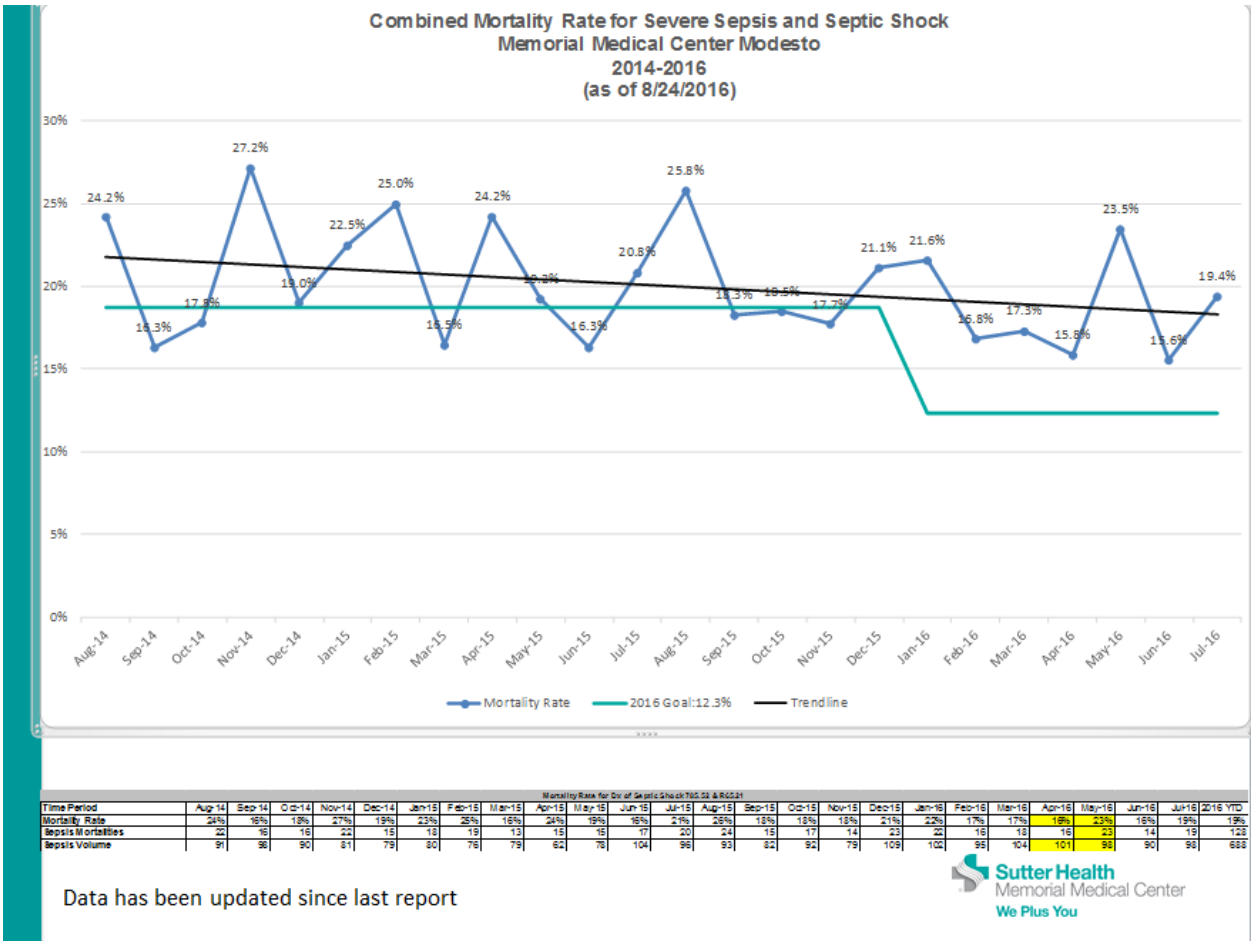
Appendix U

SWOT Analysis

Strengths	**Weaknesses**
• Dedicated EMS Base Nurse Liaison. • New ED Expansion with additional exam room and triage space adding 5700 square feet to the department. • Highly skilled, dedicated staff. • Longstanding Relationship with Mountain Valley EMS Agency because of Trauma, STEMI and Stroke designation. • EPIC Electronic Health Record with the ability for excellent data abstraction. • Dedicated Informatics Nurse Specialist assigned to the ED.	• Lack of Emergency Department physician leadership engagement in process improvement. • ED, ICU and Hospitalist physician issues with bundle requirement from the Sutter Corporate Sepsis committee and feeling they did not have an opportunity in developing the guidelines. • Physician biases and complacency with process improvement efforts within the facility. • MVEMSA's medical director's focus only on AMI, and Stroke care. • MVEMSA has committed to a new process with regards to managing psychiatric patient population so feel resources are limited.
Opportunities	**Threats**
• Partnering with EMS to improve early identification of the sepsis patient in the prehospital environment. • Improving overall mortality for septic patients at Memorial Medical Center by evaluating patients being transported from local skill nursing facilities and long term acute care facilities. • Educating SNF and LTAC staff to improve the identification of the patient with severe sepsis and septic shock in a timely manner and informing EMS. • Integrate community and consumer input within governance structure. • Partnering with Sutter Gould physician hospitalist group to improve timeliness of care.	• Potential lack of involvement from MVEMSA's Medical Director in supporting the initiative. • Competing priorities form EMS due to their new pilot study for bypassing ED's for medical screening of psychiatric patients. • Lack of urgency with treatment guidelines from EMS. • Failure to partner with SNF's and LTAC's could negatively impact mortality and ALOS results due to late identification.

Appendix V

Combined Mortality Rate for Severe Sepsis and Septic Shock



Time Period	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	2016 YTD
Mortality Rate	24%	16%	18%	27%	19%	23%	25%	16%	24%	19%	16%	21%	26%	18%	18%	18%	21%	22%	17%	17%	16%	23%	16%	19%	19%
Sepsis Mortalities	22	16	16	22	15	18	19	13	15	15	17	20	24	15	17	14	23	22	16	18	16	23	14	19	128
Sepsis Volume	91	98	90	81	79	80	76	79	62	78	104	96	93	82	92	79	109	102	95	104	101	98	90	98	688

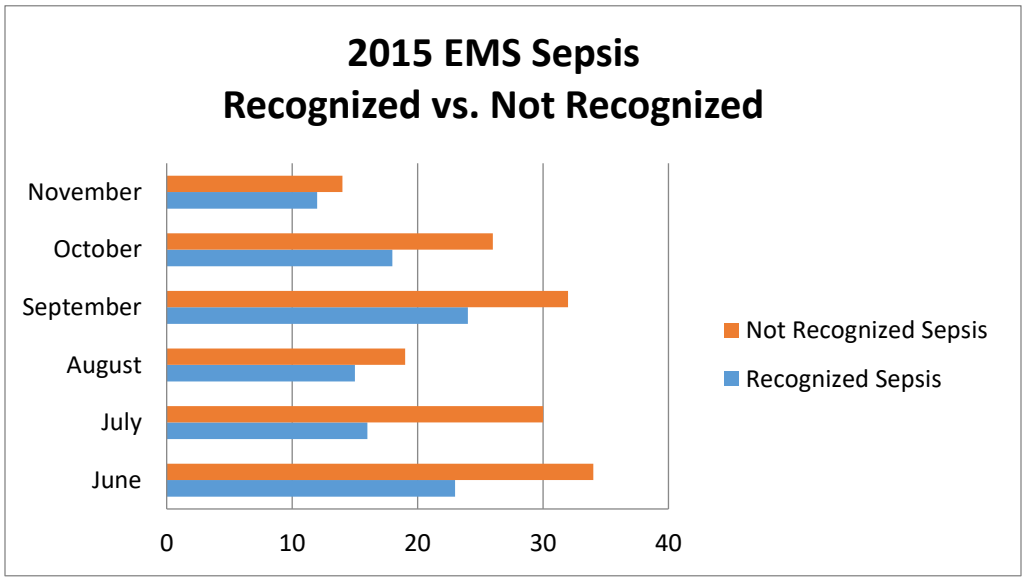
Data has been updated since last report

Sutter Health
Memorial Medical Center
We Plus You

April 2016: Severe Sepsis 15.8% Mortality – 2 charts found to be coded incorrectly/mortality from sepsis not primary reason for death. Actual combined mortality rate should be 13.8%.
May 2016: Septic Shock 23.5% Mortality – 6 charts found to be coded incorrectly/mortality from sepsis not primary reason for death. Actual combined mortality rate should be recorded at 17.3%

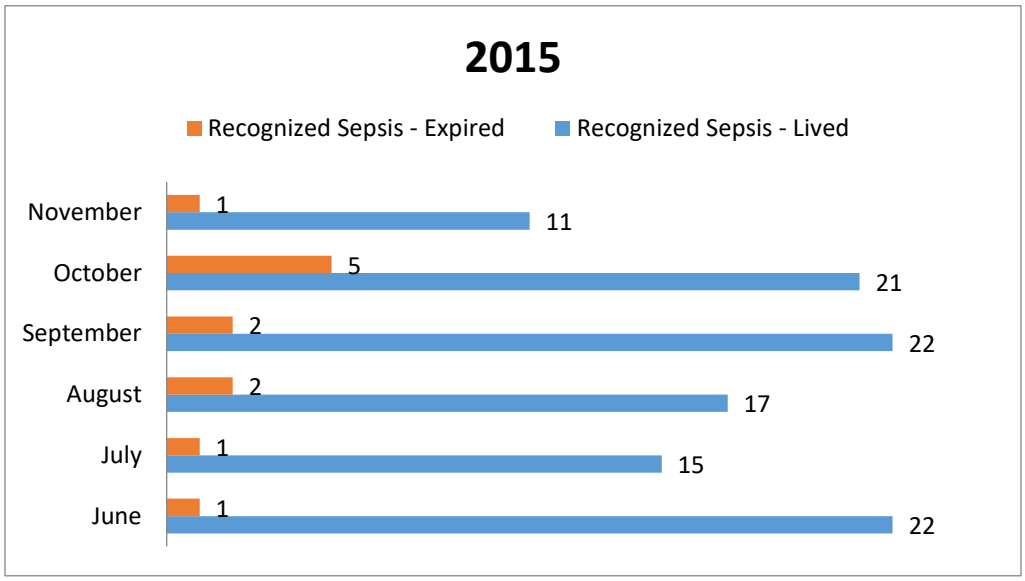
Appendix W

2015 EMS Sepsis Recognized versus Not Recognized



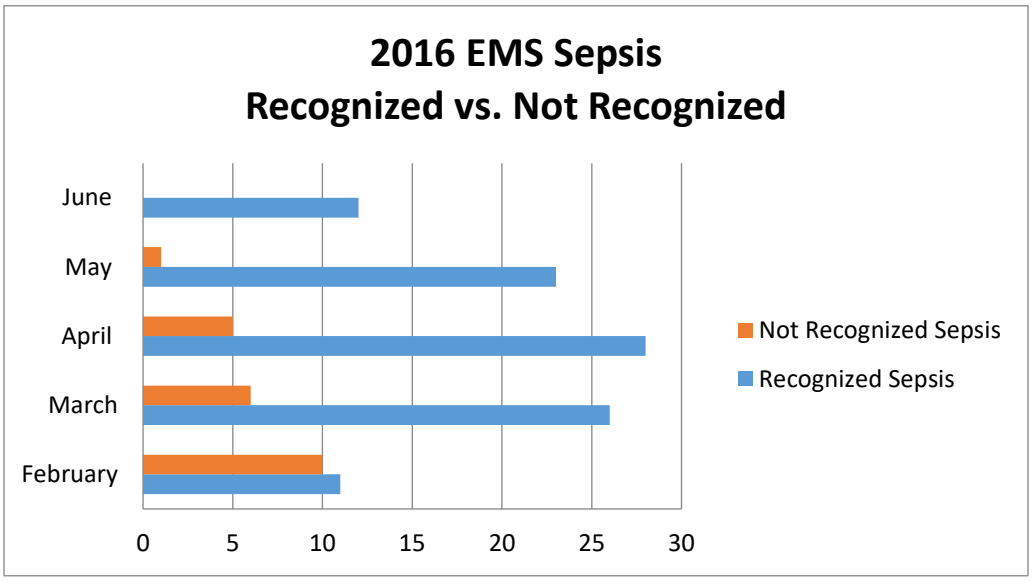
Appendix X

2015 EMS Sepsis Expired versus Lived on Recognized Cases



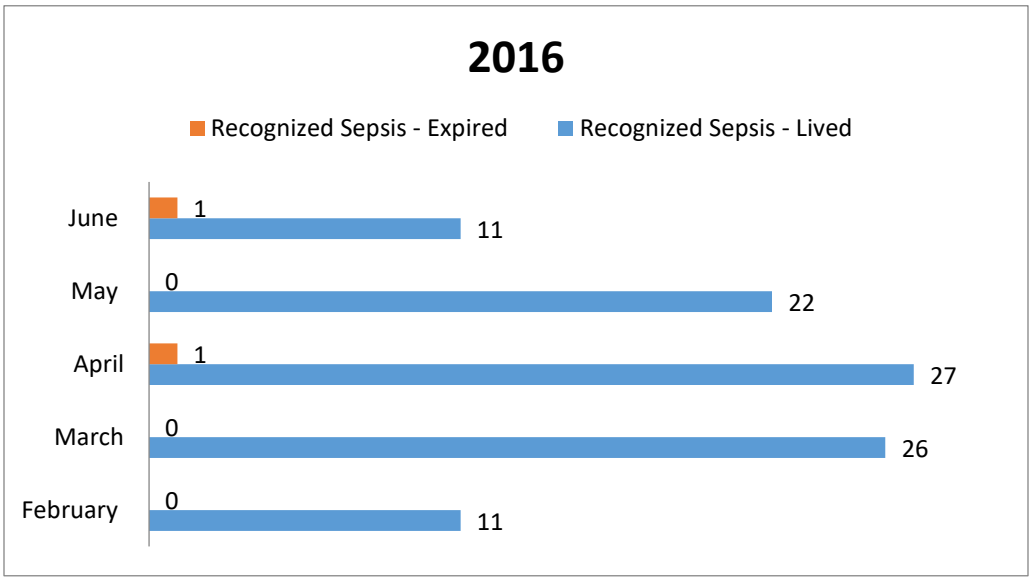
Appendix Y

2016 EMS Sepsis Recognized versus Not Recognized



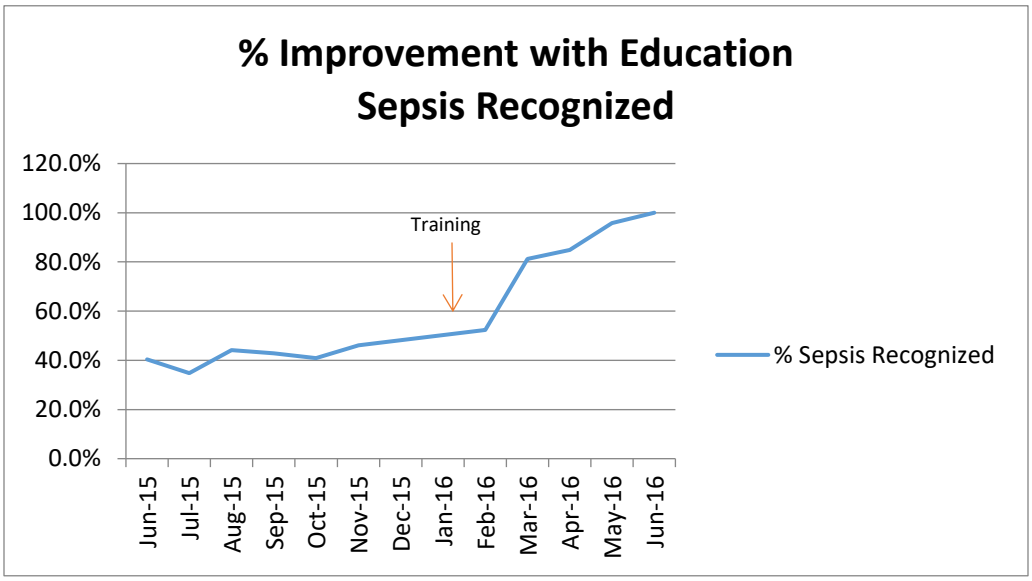
Appendix Z

2016 EMS Sepsis Expired versus Lived on Recognized Cases



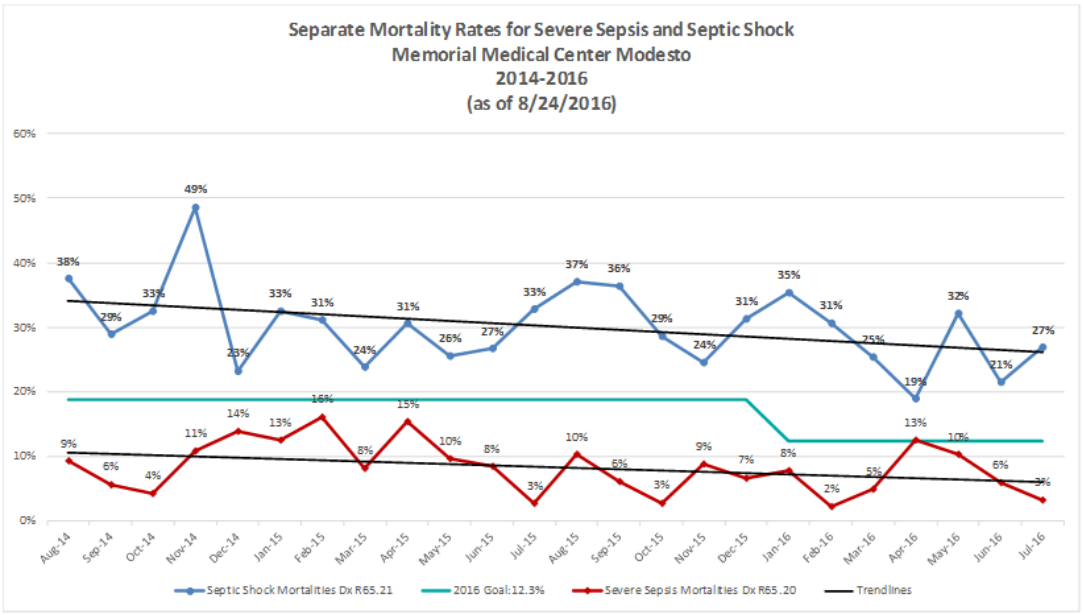
Appendix AA

Improvement through Sepsis Education



Appendix BB

Mortality Rates for Severe Sepsis and Septic Shock



Mortality Rate for Dx of Septic Shock 785.52 & R65.21

Time Period	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	2016 YTD
Mortality Rate	38%	29%	33%	49%	23%	33%	31%	24%	31%	26%	27%	33%	37%	36%	29%	24%	31%	35%	31%	25%	19%	32%	21%	27%	27.1%
Sepsis Mortalities	18	13	14	17	10	13	14	10	11	12	12	19	20	12	16	11	20	18	15	16	10	19	12	18	108
Sepsis Volume	48	45	43	35	43	40	45	42	36	47	45	58	54	33	56	45	64	51	49	63	53	59	56	67	398

Mortality Rate for Dx of Severe Sepsis 995.92 & R65.20

Time Period	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	2016 YTD
Mortality Rate	9%	6%	4%	11%	14%	13%	16%	8%	15%	10%	8%	3%	10%	6%	3%	9%	7%	8%	2%	5%	13%	10%	6%	3%	5.0%
Sepsis Mortalities	4	3	2	5	5	5	5	3	4	3	5	1	4	3	1	3	3	4	1	2	6	4	2	1	20
Sepsis Volume	43	53	47	46	36	40	31	37	26	31	59	38	39	49	36	34	45	51	46	41	48	39	34	31	398

Data has been updated since last report

Sutter Health
Memorial Medical Center
We Plus You

April 2016: Severe Sepsis 13% Mortality – 2 charts found to be coded incorrectly/mortality from sepsis not primary reason for death. Actual mortality rate should be 8%.
May 2016: Septic Shock 32% Mortality – 6 charts found to be coded incorrectly/mortality from sepsis not primary reason for death. Actual mortality rate should be recorded at 22%

Appendix CC

Monthly Sepsis Patient Cost of Care

Memorial Medical Center
Total Costs of Care for Sepsis Patients by Month
Jul 2014 – Jun 2015

Month/Year	**Total Day's by Month**	***Average Daily Cost by DRG's 870, 871 & 872**	**Total Cost of care for Sepsis by month for July 2015 – Feb 2016**
Jul – 2014	**678.6**	$1900.00	$ 1,289,340.00
Aug – 2014	**722.5**	$1900.00	$ 1,372,750.00
Sep – 2014	**757.1**	$1900.00	$ 1,438,490.00
Oct – 2014	**870.3**	$1900.00	$ 1,653,570.00
Nov – 2014	**773.4**	$1900.00	$ 1,469,460.00
Dec – 2014	**1069.6**	$1900.00	$ 2,032,240.00
Jan – 2015	**981.1**	$1900.00	$ 1,864,090.00
Feb – 2015	**837.8**	$1900.00	$ 1,591,820.00
Mar – 2015	**854.2**	$1900.00	$1,622,980.00
Apr – 2015	**652.1**	$1900.00	$1,238,990.00
May – 2015	**649.1**	$1900.00	$1,233,290.00
Jun – 2015	**608.1**	$1900.00	$1,155,390.00
	9453.9		**$ 17,962,410.00**

* Average Daily Cost's for DRG's 870, 871 & 872 are based on the entire inpatient stay including ancillary services

Source: MMC Finance Department, Monthly Reports, Jul 2014 – Jun 2015

Appendix DD

Project Timeline

MILESTONE	DATE
Project Planning Phase	
❖ Select Implementation Team	12/10/2014
❖ Form Committee	12/10/2014
❖ Meetings Scheduled	12/10/2014
❖ Develop Agenda	12/10/2014
❖ 2015 MMC Sepsis Improvement Team Monthly Meeting	1/28/2015
❖ 2015 MMC Sepsis Improvement Team Monthly Meeting	2/25/2015
❖ 2015 MMC Sepsis Improvement Team Monthly Meeting	3/11/2015
❖ 2015 MMC Sepsis Improvement Team Monthly Meeting	3/25/2015
❖ 2015 MMC Sepsis Improvement Team Monthly Meeting	4/8/2015
❖ Sutter Health Sepsis Initiative – Sepsis Implementation 6-Hour Planning Meeting to Review Standardized Work and Process Mapping for Implementation/Go Live on 6/1/2015	4/14/2015
❖ Start Date for 2-Hour Sepsis Education for all hospital Registered Nursing Staff	4/15/2015
❖ First Charge Nurse Forum – Empowering Nursing into the Future	4/20/2015
❖ 2015 MMC Sepsis Improvement Team Bi-Monthly Meeting	4/22/2015
❖ Second and Third Charge Nurse Forums – Empowering Nursing into the Future	4/27/2015
❖ Sepsis Presentation to Medical Staff	5/4/2015
❖ 2015 MMC Sepsis Improvement Team Bi-Monthly Meeting	5/13/2015
❖ Sutter Health System's Rapid Process Improvement Workshop (RPIW)/Follow-up Kaizen Day Event	5/21/2015
❖ Sepsis Community of Interest Meeting at Sutter Health System Headquarters following the RPIW Workshop	5/21/2015
❖ Last Opportunity for Registered Nursing Staff to Attend 2015 Mandatory Sepsis Education class	5/26/2015
❖ 2015 MMC Sepsis Improvement Team Bi-Monthly Meeting	5/28/2015

❖ Meeting with Mountain Valley EMS Administration to Discuss Sepsis Education Regarding Recognition by Pre-Hospital Personnel and ED Alert Prior to Arrival	8/14/2015
Implementation Phase	
❖ Go Live for MMC's New 6-Hour Bundle Sepsis Initiative	6/1/2015
❖ Emergency Department & Renal Telemetry Admission Process Week-Long Kaizen Event	6/1/2015
❖ End of Week-Long Go Live 6-Hour Bundle Sepsis Initiative	6/5/2015
❖ Report out for ED/Renal Telemetry Admission Process Kaizen Event	6/5/2015
❖ 2015 MMC Sepsis Improvement Team Bi-Monthly Meeting and Evaluation of Initial Go Live Event	6/10/2015
❖ 2015 Sepsis Improvement Team Bi-Monthly Meeting	6/29/2015
❖ 2015 Sepsis Improvement Team Bi-Monthly Meeting	7/8/2015
❖ 2015 Sepsis Improvement Team Bi-Monthly Meeting	7/22/2015
❖ 2015 Sepsis Improvement Team Bi-Monthly Meeting (Resuming Monthly Meeting Following Go Live)	8/26/2015
❖ 50 Minute Sepsis Presentation at the Stanislaus County EMS Symposium to 89 Stanislaus County EMS providers.	2/11/2016
❖ Sepsis Education with American Medical Response Paramedic and EMT Responders at their annual EMS skills days (7 separate sessions)	2/12/2016, 2/15/2016, 2/18/2016, 2/23/2016, 2/25/2016, 2/26/2016 & 2/29/2015
Evaluation Phase	
❖ 2015 Sepsis Improvement Team Monthly Meeting	9/14/2015
❖ 2015 Sepsis Improvement Team Monthly Meeting	10/13/2015
❖ 2015 Sepsis Improvement Team Monthly Meeting	10/28/2015
❖ 2015 Sepsis Improvement Team Monthly Meeting	11/25/2015
❖ 2015 Sepsis Improvement Team Monthly Meeting	12/30/2015

❖ Pre-Education Assessment Survey for EMS Knowledge of Severe Sepsis and Septic Shock	1/4/2016
❖ 2016 Sepsis Improvement Team Monthly Meeting	1/27/2016
❖ 2016 Sepsis Improvement Team Monthly Meeting	2/24/2016
❖ Post-Education Assessment Survey for EMS Knowledge of Severe Sepsis and Septic Shock	3/8/2016
❖ 2016 Sepsis Improvement Team Monthly Meeting	4/27/2016
❖ 2016 Sepsis Improvement Team Monthly Meeting	5/25/2016
❖ 2016 Sepsis Improvement Team Monthly Meeting	6/29/2016
❖ 2016 Sepsis Improvement Team Monthly Meeting	7/27/2016
❖ Compiling Data for Project Completion	8/1/2016
❖ Project Completion and Wrap-Up	8/15/2016
Project Presentation to ELDNP Committee, Professors and Peers	**12/15/2016 @ 3:00 PM**

Appendix EE

Communication Plan

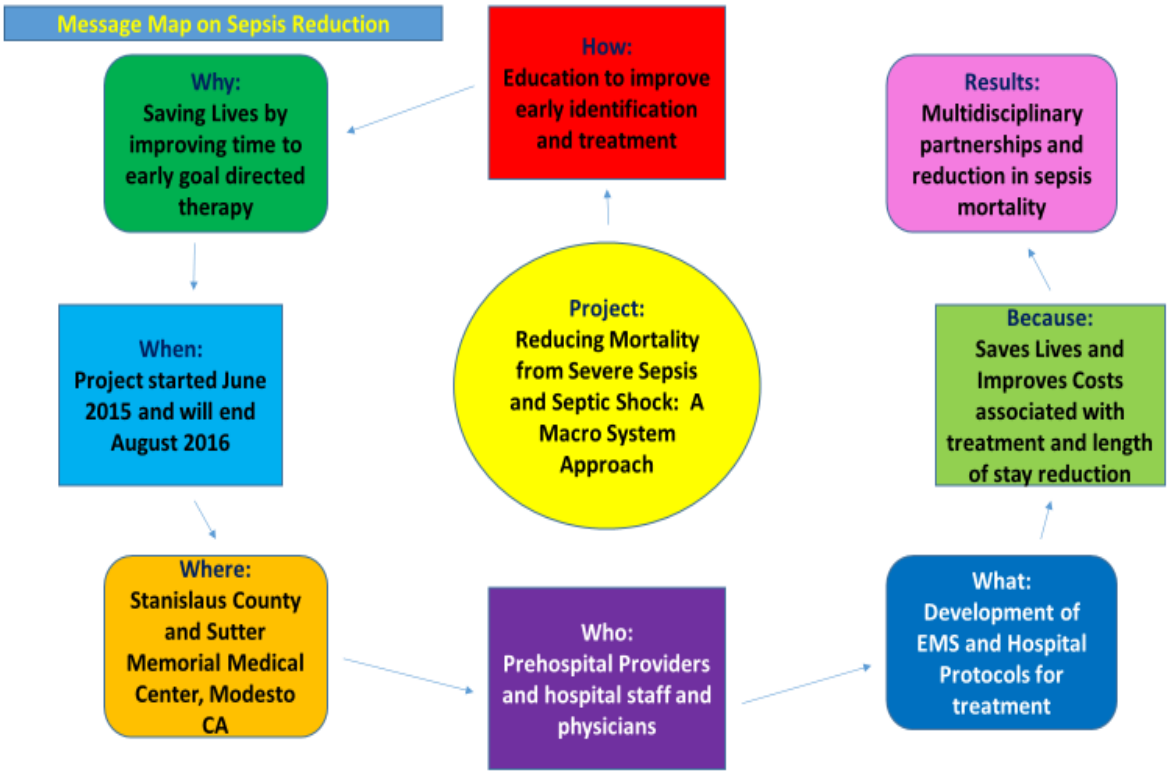
Message Map Stakeholder: Sutter System & Memorial Medical Center's Senior Leadership		
Key Message 1	Key Message 2	Key Message 3
Concentration of efforts on education and training under the Surviving Sepsis Campaign 2012 three and six-hour treatment bundle recommendations will improve timeliness of care to patients presenting with complications from sepsis, ultimately reducing mortality and overall hospital length of stay.	Opportunity to leverage relationships with ED, ICU and Hospitalist physicians along with facility registered nursing staff to improve treatment and outcomes for all patients arriving with complications from sepsis.	Literature has identified, partnerships with EMS have improved Trauma, AMI and Stroke care. Partnering with MVEMSA will be critical to improving treatment and outcomes for patients with sepsis complications.

Message Map Stake Holder: Memorial Medical Center's Physicians & Staff Nurses		
Key Message 1	Key Message 2	Key Message 3
Sepsis is the 10th leading cause of death in the United States and costs 20.3 billion annually to treat. Improving care under the Surviving Sepsis Campaign 2012 three and six-hour bundles will improve timeliness of care to patients presenting with complications from sepsis, leading to reductions in mortality and hospital length of stay.	Timely identification, communication and initiation of IV fluids and antibiotics will improve survivability of patients with severe sepsis and septic shock complications.	Partnerships with EMS with early activation of a prehospital sepsis alert prior to arrival in the emergency department will allow for timely continuation of treatment under the bundle initiatives.

Message Map Stakeholder: Mountain Valley Emergency Medical Services Agency		
Key Message 1	Key Message 2	Key Message 3
Mortality from sepsis increases by 8% per hour if left untreated. Similar to STEMI and Stroke chain of survival, identification by EMS is key to reducing mortality and improving outcomes.	Development of treatment protocols for IV access and administration of fluid boluses prior to arrival will be key to success.	Prenotification through a Sepsis alert to the receiving ED will allow for continuation of treatment and timely lactate measurement and antibiotics administration.

Appendix FF

Project Message Mapping Diagram

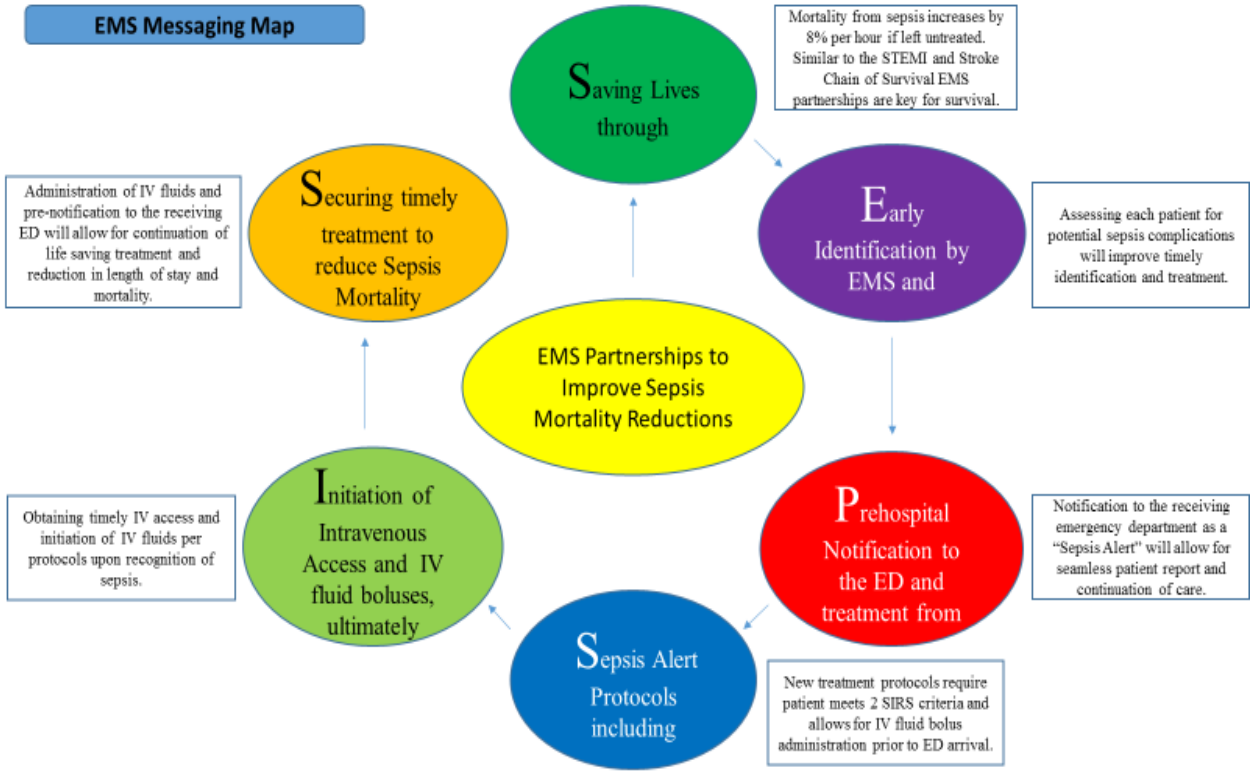


Appendix GG

Hospital Stakeholder Message Mapping Diagram

Appendix HH

EMS Stakeholder Message Mapping Diagram



Appendix II

DNP Project Letter of Support

Sutter Health
Memorial Medical Center
We Plus You

1700 Coffee Road
Modesto, CA 95355
(209) 526-4500

October 31, 2016

From: Betty Lopez, CNE

To: Scott Baker, USF ELDNP Student

Subject: Letter of Support for DNP Project

This letter serves to document organizational support from Sutter Memorial Medical Center, for Scott Baker's Doctor of Nursing Practice Project titled "Reducing Mortality from Severe Sepsis and Septic Shock: A Macrosystem Approach".

With Regards,

Betty Lopez

Betty Lopez, RN, DNP(c), MPA, CENP
Chief Nurse Executive
Memorial Medical Center
1700 Coffee Road
Modesto, CA 95355
Office: (209) 572-7266
Email: LopezB@sutterhealth.org