Title of Entry:  Improving Sepsis Core Measure Compliance through the use of a Predictive Analytic supported Sepsis Alert Protocol

Division:  Large Organizations

Award:  Optimal Operations

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Date Implemented:  04/01/2016
Date Results Achieved:  01/31/2018

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Executive Summary

Title
Improving Sepsis Core Measure Compliance through the use of a Predictive Analytic supported Sepsis Alert Protocol.

Description of Problem
The incidence of sepsis is increasing due to aging populations, complex co-morbidities, and antibiotic-resistance. In 2013, 6.2% of national costs of all hospitalizations were due to sepsis. This has resulted in aggregate healthcare costs surpassing $24 billion annually. Sepsis has now become a reportable Center for Medicare Services (CMS) core measure as of October 2015. Contributing to cost, morbidity, and mortality is the lack of recognition and compliance with standards of care by clinicians. The incremental length of stay and costs associated with treating sepsis recognized early through the use of electronic medical record (EMR) predictive analytic scoring and approached with a process driven framework, like that of a sepsis alert, has the potential to improve the quality of care, outcomes, and overall costs. The AIM of this project was to increase core measure compliance in the adult acute care population to greater than 70% within one year.

Evidence
In the US, severe sepsis/septic shock patients experience significant mortality. The Pennsylvania Department of Health has reported that Pennsylvanians incur 84,000 admissions and 7,000 deaths annually related to sepsis. The use of standard practice protocols and guidelines has demonstrated improved outcomes for septic patients. Acute Care Hospitals are experiencing increased patient volumes and higher patient acuity, exacerbating delayed sepsis recognition. Mortality in severe sepsis is directly related to the timeliness of goal-directed therapy. Mobilizing sepsis screening through the use of predictive analytic scoring and a sepsis alert framework seeks to impact the time sensitive core components of sepsis care through a multidisciplinary process that guides clinicians to complete the CMS requirements of sepsis care and meet benchmarks for quality.

Baseline Data
Currently, CMS reports compliance with sepsis bundles statewide and nationally at 46 and 49% respectively, with no true top decile national benchmark. However, top decile performance has been estimated to be greater than 70% nationally. A baseline prevalence point audit identified that application and use of the CMS care bundles was low. The project site’s average compliance with sepsis core measures of care was 57% pre-intervention.

Intervention
Use of an interdisciplinary approach, enlisting input from all levels of clinicians assisted in creating a sepsis alert protocol (Appendix A, figure1). This protocol driven framework guides clinicians to complete all elements of the sepsis bundles and was mobilized and implemented through a screening process supported by predictive analytics. The electronic medical record alerts clinicians via predictive analytic scores and best practice alerts to screen and identify the septic patient, place a call to telecommunications, and initiate a hospital wide alert. This activates rapid response providers to assist clinicians in following the sepsis alert protocol and bring much needed resources to the bedside. All clinicians work within the same care framework to assure consistency of care and follow-up.

Results
Compliance with the CMS core measure rose by 26.3% between April 2016 and January 2018. The post intervention period saw 529 of 736 severe sepsis/septic shock cases having all components of core measure care completed… an overall 72 % completion rate. The total cost savings during the project time period is estimated to be $1,262,260.12 at the project site.
Assessment

The goal to improve early identification of severe sepsis and subsequently the time to completion of the sepsis bundles in the acute care inpatient hospital setting is paramount and technically complex. The AIM of this project was to increase core measure compliance in the adult acute care population to greater than 70% within one year. Goal attainment was achieved through the use of predictive analytics to mobilize early sepsis screening and a sepsis alert protocol (Appendix, figure 1).

Evidence/Literature Review

In the U.S., severely septic patients and patients in septic shock continue to experience significant mortality. Severe sepsis kills an estimated 1,400 people worldwide every day. This often fatal infectious process accounts for an estimated 258,000 deaths annually. In the United States (U.S.) there are approximately 750,000 new sepsis cases each year. Globally, it impacts 20-30 million people each year. Mortality associated with severe sepsis remains at 30-50% and approaches 60% when associated with shock. The Surviving Sepsis Campaign, a global initiative to reduce mortality from sepsis, sought to create a collaborative effort to improve recognition and treatment of sepsis and reduce mortality rates associated with the condition.

An aging population, complexity of co-morbidities, and the spread of antibiotic-resistant organisms have added to the upsurge of sepsis. In the current health care climate, seventy percent of patients require frequent medical care due to complex co-morbidities, thus further exacerbating the incidence and severity of sepsis. In 2013, a review of sepsis nationally revealed costly prolonged stays in critical care with complex therapies. More than 6.2% of national costs for all hospitalizations were a result of sepsis. This has resulted in aggregate healthcare costs approaching $24 billion. Knowing the severity and cost of sepsis, it became a reportable CMS measure since October 2015.

Needs Assessment/Research

The incremental length of stay and costs associated with treating a case of sepsis recognized early through a predictive analytic scoring system and approached with a process driven framework like that of a sepsis alert has the potential to improve the quality of care and reduce the overall costs to the health network. In response to performance associated with sepsis and the known high rate of hospital-acquired sepsis complications, the project site Sepsis Performance Improvement (PI) committee was established. Under the auspice of the Network Sepsis committee, this separate PI team was assembled to combat the problem, targeting the emergency and inpatient patient populations. The needs assessment began with reviewing the networks bundle compliance… this was less than desired at 57%. This introspective review prompted research into best practice strategies for bundle compliance improvement.

The project site has experienced increased patient volumes and higher patient acuity. These factors contribute to complicated identification, longer lengths of stay, and delayed patient throughput. To improve identification of the patient who is at risk of developing sepsis, a predictive analytic scoring system was developed from live data sets within the electronic medical record. This was used to mobilize a sepsis screening process and initiate a sepsis alert. The objective of the sepsis alert protocol is to initiate early goal directed therapy, with a secondary objective of expediting the patient admission or transfer process with a goal of improving compliance. The alert protocol guides the clinician to complete all sepsis bundle care (Appendix, figure 2). Collectively, the elements of the bundle have greater impact on outcomes than each element performed separately. Severe sepsis and septic shock are clinical entities encountered frequently in both the emergency department and the inpatient acute care setting.

Benchmarking/Baseline Data

The mortality for severe sepsis/septic shock ranges from 30-60%. Measuring compliance with the severe sepsis bundles allows one to judge how well an institution is performing at caring for sepsis. The measure is defined as the percent of cases for which all bundle elements in the severe sepsis bundles were completed on time. In early 2016 the project site network determined compliance was less than desired. An audit conducted by the network Sepsis PI determined that the emergency patient setting was
a high risk location for presentation of sepsis with a significant potential for unrecognized clinical
decline and progression to severe sepsis, often in the inpatient setting. Repeated audits determined that a
sepsis alert protocol that includes nursing, medicine, and advanced practice could identify at risk
patients for severe sepsis.

Currently, CMS reports compliance with sepsis bundles statewide and nationally at 46 and 49 percent respectively. In 2016, it was identified that our network’s sepsis core measure compliance was 57%, higher than national averages but lower than desired. A baseline prevalence point audit was performed in the network emergency departments, this identified that application and use of the CMS care bundles was low despite electronic medical record applications and continued sepsis care education to providers and nursing.

**Intervention**

Early identification and treatment of patients admitted with, or developing, severe sepsis and/or septic shock began by improving early identification of this patient population. Improving identification then mobilized the screening process in an effort to initiate the evidence-based guidelines of the SSC. The objective was to initiate early goal directed therapy through early mobilization of the screening process utilizing predictive scoring and a protocol driven framework that guides clinicians to complete all elements of the sepsis bundles. The protocol was implemented through a hospital alert system. The predictive scoring system alerts the clinician through a best practice alert that a patient is at risk of developing sepsis. The clinician screens the patient for sepsis and if positive places a call to telecommunications, and initiates a hospital wide alert to bring much needed resources to the bedside. The sepsis alert activates rapid response providers to assist clinicians in following the sepsis alert protocol. All clinicians involved work within the same care framework to maintain consistency of care, assure all elements of the bundle are completed timely, and ongoing follow up care is scheduled for completion.

Part of the work the project site’s PI group needed to do was to secure input related to sepsis recognition. An interdisciplinary approach was taken, enlisting input from the following groups: Emergency Nursing (including both nurses and technicians), Emergency Medical Physicians, Emergency Medicine Advanced Practice, Critical Care Medicine (nursing, advanced practice and physician services), Nursing Administration, Telecommunications and the Network Sepsis committee. Administrative support from Emergency Medicine Medical and Nursing management, Intensive Care Nursing, Rapid Response, and Education Services were also essential in moving this project forward. See intervention plan below for how this was accomplished.

**Strategies for Intervention Implementation**

- Developed sepsis alert process with emergency medicine staff and physicians, October 2016. (pocket cards obtained to distribute to all clinicians)
- Developed multidisciplinary education. Live, large multidisciplinary grand rounds held.
- Emergency sepsis alert tip and checklist developed and distributed to staff, October 2016.
- Emergency medicine/attending physician identified as ordering physician for Sepsis Alert.
- Telecommunication education on sepsis alert page to rapid response, nursing supervisor, laboratory services, pharmacy, and radiology services, October 2016.
- Development of predictive analytic scoring for sepsis, December 2016.
- Implementation of predictive analytic scoring in electronic medical record. This allowed statistical analysis of scores and development of threshold score for mobilization of screen and sepsis alert, Jan 2017.

**Implementation Plan**

The implementation plan and interventions were guided by knowledge surveys to identify history and misconceptions of sepsis care at the project institution.

- Misconceptions.
Lactate levels do not need to be repeated at a level of 2.
Antibiotic fluids are counted as part of the IV fluid bolus.
Antibiotics must be started within the hour.
A history of heart failure precludes IV fluid administration.
Documentation of fluid administration by the provider meets CMS requirements.

Little understanding of:
- 3 and 6 hour sepsis bundle compliance.
- The importance of both nursing and physician documentation.

A series of point prevalence reviews for sepsis compliance occurred via retrospective chart review between May 2016 and October 2016. Results were used to measure the effects of the changes undertaken. Barriers to implementation were assessed and addressed in the following manner.

Long history/culture of viewing sepsis care as highly individualized.

- Post education point prevalence study revealed opportunity for improvement and weekly audits for sepsis bundle compliance were started, November 2016. This resulted in heightened awareness of importance of CMS sepsis core measures and multidisciplinary accountability.
- Network Sepsis education regarding bundle compliance, October 2016.
- Emergency nursing sepsis checklist accountability tool.

Staff perception that repeat lactate not needed if 2 and under.

- Evidence based study shared related to predictive value of lactate 2 or greater for developing sepsis October 2016.
- Monitored lactate order omissions related to sepsis alert patients and shared results.

Equipment availability
- Sepsis alert reference forms available at all ED physician documentation locations.
- Sepsis checklist added to EMR.
- Addition of vascular access device availability confirmed for use by ED nursing staff.

Information Technology
- The project site ED realized that lab sticker re-timing with the correct blood draw time was crucial to successful completion of CMS sepsis core measure. Project site nursing administration and the network sepsis committee worked together to create a protocol and pathway that supported blood culture timing compliance.
- Clinical Practice Advisory issued regarding blood culture timing.
- Introduction of predictive modeling and its utility in sepsis identification and care.
- Education to nursing and medicine regarding predictive analytics use in the emergency department and acute care hospital settings.
- C-Statistic analysis of predictive analytics across network January to June of 2017.
- Electronic predictive threshold scoring alerts developed and implemented.

Patient refusal/changes in code status.

- Education regarding importance of documentation of care refusals.
- Importance of comfort care documentation.

Results

Achievement

The project site’s sepsis alert protocol surpassed the identified goal to increase compliance with CMS core measures. The project site compliance rose by 26.3% (pre intervention compliance average = 57%/ post intervention compliance average 72%, 72-57/57 = 26.3% increase) which has been sustained (Appendix A, graph 1). Omissions in core components of care have decreased (Appendix A, graph 2). The pre-intervention period saw 224 of 393 severe sepsis/septic shock cases with all components of core measure care completed... a 57% completion rate. The post intervention period saw 529 of 736 severe
sepsis/septic shock cases having all components of core measure care completed... a 72% completion rate. The network Sepsis PI committee is continuing to monitor this data monthly.

**Financial Implications**

The total inpatient cost savings is estimated to be $1,262,260.12 at the project site over the post intervention period. This was calculated as follows: severe sepsis without shock average length of stay over the study period was 8.33 days and average length of stay for a patient with severe sepsis and shock was 11.36, with the difference being 3.03 days. In the post-implementation period 529 of 736 sepsis patients had all components of the sepsis core measure completed, thus 3.03 x 529 equals 1602.87 patient days saved. The cost difference per day between severe sepsis and severe sepsis with shock care is $787.5/day. Thus, 1602.87 patient days x $787.5/day = $1,262,260.12. This further establishes the significant impact of a Sepsis Alert protocol augmented by predictive analytics.

**Adaptability**

The overall success of this project has impacted the project entity in the following areas... patient safety, quality, and finance. Two of the hospitals at the project site were named top performers in sepsis care by the Premier Hospital Improvement Innovation Network. This success sparked interest in sepsis predictive modeling. Continued implementation and spreading change plans include:

- Individual entity based sepsis compliance committees formed throughout the network.
- Documentation of sepsis initial assessment and reassessment compliance in the electronic medical record system drastically improved.
- Sepsis alert success to be standard of care in Network.
- Transition of sepsis alert to predictive analytic use—Network wide impact.
- National and international conference presentations on sepsis alert process (Epic UGM) and predictive analytic use to identify sepsis (Epic XGM).

**Appendix**

**Figure 1**

**Sepsis Alert Protocol**

1. Patient exhibits signs/symptoms of a new infection

   ***Nursing responsibilities***
   
   RN identifies possible SIRS/SEPSIS/SEVERE SEPSIS presentation as evidenced by:
   
   a. Two positive SIRS criteria (Hypothermia/Hyperthermia/Tachycardia/Tachypnea/Altered Mental Status)
   b. Hypotension (Systolic BP<90)
   c. Call placed to provider (Attending or Rapid Response depending on time of day)

   ***Provider Responsibilities (Attending Service)***
   
   Provider identifies a patient with severe sepsis:
   
   a. Suspicion of NEW infection
   b. + 2 sirs criteria
   c. Evidence of end organ damage
      i. Lactate > 2.0
      ii. Other criteria for severe sepsis

2. A patient identified with severe sepsis/septic shock: Provider Initiates a SEPSIS ALERT: Dial 5555

   ***Nursing Responsibilities***
   
   a. 2 nurses to bedside if available. Utilize Sepsis Alert Checklist.
   b. Second line if unable to obtain IV access, utilize all available resources (i.e. Ultrasound, provider places central line, alert attending)
   c. Draw additional labs including lactate and blood cultures. Please utilize the sepsis order set.

   ***Provider responsibilities***
   
   a. Identification of SIRS/SEPSIS/SEVERE SEPSIS/SEPTIC SHOCK
   b. Appropriate lab/ray studies ordered (2 hour repeat lactate very important)
   c. Appropriate monotherapy/dual therapy antibiotic. Antibiotics within 1 hour of sepsis presentation.
   d. Appropriate amount of fluids:
      i. Severe sepsis: some fluids
      ii. Septic shock (hypotension or lactate >/= 4) Fluids ordered to total 30ml/kg (please use sepsis order set for septic shock) must be infused within three hours of presentation.
   e. Fill out SEPSIS INITIAL ASSESSMENT (complete at initial identification)
   f. Fill out SEPSIS REASSESSMENT (complete after initial fluid bolus completed)
   g. Start vasopressors through appropriate IV access if signs of end organ damage/hypotension persist despite adequate fluid resuscitation.
   h. Discuss transfer and care with rapid response team to facilitate appropriate place for admission (stepdown/ICU)

The Sepsis Alert will be page out to:

   a. Nursing supervisor
   b. Rapid Response Team
   c. Pharmacy
   d. Lab
   e. Radiology
**Figure 2**

**Sepsis Bundles**

__Sepsis Bundle__
- **Sepsis Velcro**
  - Initial assessment
  - Complete blood count
  - Cultures
  - Blood glucose
  - CBC
  - LFTs
  - U&Es
  - Blood culture
  - Pulmonary artery catheter
  - Central venous catheter
  - Administer broad-spectrum antibiotics
  - Administer 30 mL/kg NS in 30 minutes

**Sepsis Shock Bundle**
- **Sepsis Velcro**
  - Initial assessment
  - Complete blood count
  - Cultures
  - Blood glucose
  - CBC
  - LFTs
  - U&Es
  - Blood culture
  - Pulmonary artery catheter
  - Central venous catheter
  - Administer broad-spectrum antibiotics
  - Administer 30 mL/kg NS in 30 minutes

**Sepsis/Shock Algorithm**

1. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes

2. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes

3. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes

4. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes

5. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes

6. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes

7. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes

8. **Sepsis/Shock Algorithm**
   - **Initial Assessment**
     - Complete blood count
     - Cultures
     - Blood glucose
     - CBC
     - LFTs
     - U&Es
     - Blood culture
     - Pulmonary artery catheter
     - Central venous catheter
     - Administer broad-spectrum antibiotics
     - Administer 30 mL/kg NS in 30 minutes
Graph 1
Core Measure Compliance

Project Site Sepsis Compliance Rates

Graph 2
Network Omissions of Bundle Components
References
Williams, Darleen A., and Katrin Breault. "Emergency Department Sepsis Alert and Practice Protocol (EDSAPP)."