A Screening Tool for Early Recognition and Treatment of Sepsis

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Abstract

Purpose: This study investigates the use of a sepsis screening tool to decrease the length of time from triage to treatment.

Design: In this exploratory study, a convenience sample was drawn from all patients triaged in a critical access hospital emergency department in a six-month period from April 1 through September 30, 2012 and April 1 through September 30, 2013 with a total number of patients of 10,143 for both years. Each patient who was triaged in 2013 was screened for sepsis using the sepsis screening tool and then suspected and positive screens were compared to patients in 2012 that had complaints consistent with potential sepsis.

Methods: Data was analyzed using descriptive statistics and Welch t-tests, chart reviews and the sepsis screening tool.

Findings: The use of the sepsis screening tool in triage reduced the time from triage to treatment from 29.2 minutes in 2012 to 15.5 minutes in 2013. Time from triage to treatment is significant because the overall length of time to treatment impacts the morbidity and mortality of septic patients.

Conclusions: The use of a sepsis screening tool in triage by the registered nurse positively affects the time to treatment by reducing the overall length of time to treatment of those patients with suspected sepsis.

Clinical Relevance: This study increases the knowledge base, empowers, and advances the evidence based practice of registered nurses in the emergency department. It suggests that interventions can be used to reduce the time to treatment for patients with suspected sepsis and thus improve the outcome of those patients.

Key words: sepsis, screening tool, triage, emergency department, nursing

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Sepsis is the 11th leading cause of death for adults in the United States and the 7th leading cause of death in infants according to the preliminary data from the Center for Disease Control for 2010 and 2011 (Heron, 2013; Hoyert & Xu, 2012). At least 18 million people worldwide are affected by sepsis, with a mortality rate of 23% to 30% (Vincent, 2012). The annual cost for hospital treatment of sepsis in the U.S. was 20.3 billion dollars in 2011 (Torio & Andrews, 2013). However, "approximately 90% of the American public has never even heard of sepsis, and of those who have, less than 60% know that it is a leading cause of death" (Vincent, 2012, p. 152). Increasing public awareness and educating nurses, nurse practitioners, doctors, and physician assistants can dramatically reduce the number of deaths from sepsis (Bethesda Memorial Hospital, 2012).

In 2010 Seymour et al. cited a study done by Angus, et al. (2001), which reported that sepsis is estimated to occur in one to three cases per 1,000 of the US population; this translates to over 750,000 people per year. The number of cases of sepsis reported annually has been increasing over the past 20 years (Angus, et al., 2001). Angus et al. (2001) also showed the annual cost of care for patients with sepsis was in excess of $16.7 billion nationally. In 2011, the Agency for Healthcare Research and Quality (AHRQ) reported a cost of $20.3 billion nationally (Torio & Andrews, 2013). This shows a national increase in cost for sepsis of 22% ($3.6 billion dollars).

The mortality rate from unrecognized and untreated sepsis is greater than 50% in those patients who are without intervention within 3 hours of presenting to the emergency department (ED) preferably within the first hour of recognition of sepsis (Daniels, 2011; Dellinger, et al., 2013). Nurses are on the front line for early recognition of sepsis, since nurses are often the first clinicians to interact with patients during check-in and/or triage (Vanzant & Schmelzer, 2011).

In these early minutes of care, expert nursing assessment and prompt referral to the medical provider can reduce the amount of time to lifesaving treatment; thereby saving precious minutes and lives. Sepsis bundles encourage early goal directed therapy and have demonstrated a reduction in mortality rate exceeding 46.5% (van der Vegt, Holman, & ter Maaten 2012).

Early recognition of the signs and symptoms of sepsis can be accomplished by utilizing a sepsis screening tool in the triage area of emergency rooms (Estrella, 2009; McCormick, 2009; Sweet, Marsden, Ho, Krause, & Russell, 2012). Emphasizing proper triage ensures a prompt diagnosis of those patients at higher risk for sepsis (Rivers, McIntyre, Morro, & Rivers, 2005; Dellinger, et al., 2013). The purpose of this project was to develop an evidence-based, one-page, brief sepsis screening tool and implement it into the triage area of a critical access hospital in northern Arizona.

Significance of the Problem

Because nurses are the first clinical level people to evaluate patients when they arrive at the emergency department, nurses have the responsibility and the opportunity to suspect sepsis and begin the sepsis pathway, also known as bundle (Burney, et al., 2012).

Empowering nurses with the ability to recognize sepsis and having a tool to guide them in the process during triage will impact the patient in a positive manner. It will enable the nurses, nurse practitioners, physicians and ancillary staff in the emergency department to recognize sepsis early and to save lives. In this project, we found that empowering the nurse had a substantial impact on the compliance by nurses on the use of sepsis screening tools and the sepsis protocol. Compliance in the use of the sepsis screening tool by the nurses in triage was effective in initiating the sepsis protocol and was shown with a reduction in time to triage in 2013.

Clinical Question and Measurable Objectives

The clinical question for this research project is 'Does the use of a sepsis screening tool decrease the length of time from triage to treatment in septic patients?' Implementing a single page sepsis screening tool and evaluating the data resulting from its use answered this question. It allowed the researcher to analyze the time from triage to treatment. The researcher completed an examination of the before and after screening tool data to provide information about the correlation between the use of the screening tool and the early recognition of sepsis by the nurse.

Critical Review of Literature

Sepsis is a major cause of morbidity and mortality in both adult and pediatric patients worldwide (Krastins, 2012). As a result, over the last decade there has been an increase in the number of studies regarding sepsis and the related condition of systemic inflammatory response syndrome (SIRS). These studies have indicated that early recognition and treatment of sepsis will decrease the morbidity and mortality of patients who present with signs and symptoms of sepsis.

Instituting sepsis screening tools and protocols (also known as bundles) at the first point of contact with the patient has shown a direct relationship between their use and increased recognition of sepsis; which leads to early initiation of antibiotics and fluid resuscitation for the septic patient (Krastins, 2012; Sweet, Marsden, Ho, Krause, & Russell, 2012; van der Vegt, Holman, & ter Maaten, 2012). Studies related to the topic of early recognition of sepsis through screening protocols are presented in both medical and nursing journals across the world for example Kent & Fields in 2012 and Hitti, et al. in 2012.

Early recognition of sepsis and SIRS results in lower death and complication rates from these conditions (Sweet, et al., 2012). Most of the recent research indicates that patients with signs and symptoms of sepsis, who are assessed and treated according to sepsis protocols, within the first hour of their presentation to the ED, have better outcomes and fewer complications,

when compared to patients with sepsis who do not received protocol-based care. By implementing protocols, including use of sepsis screening tools, at the patient's presentation to the hospital findings support a decrease in morbidity and mortality.

Nurses are an important part of the frontlines of recognizing and initiating care for patients with sepsis. It is for this reason that many of the screening tools are directed towards triage nurses in the ED (Tromp, et al., 2010). By educating nurses regarding the sepsis and SIRS criteria, the use of a screening tool, and the importance of initiating early recognition and treatment of sepsis, there will be a significant reduction in the mortality rate and sequela of sepsis (Krastins, 2012).

Methods and Action Plan

Population and Setting

The setting of the study was the emergency department at a small, critical access hospital in northern Arizona that services a large area consisting of two Native American reservations and four small cities in approximately a 200 square mile radius servicing approximately 32,000 people. A critical access facility is defined by the Department of Health and Human Services Centers for Medicare & Medicaid Services (2013) as a facility that is located in a rural area that under special provisions allows hospitals to provide 24 hour emergency care 7 days a week using on-site or on-call staff with specific response times for those on-call and have less than 25 inpatient beds.

Each year over 9,000 patients are treated in the ED. Patients of all ages who presented to the ED between April 2013 and September 2013 were screened for sepsis and a retrospective chart review was conducted looking at ED patients from April 2012 through September 2012. A comparison was conducted using the chart review data and screening data to compare the two

time periods for a reduction in the time from triage to initiation of treatment. This gave an overview of both pre and post sepsis screening tool implementation.

Outcomes

The sepsis screening tool was developed with the ED manager at this critical access facility. The tool utilizes the well-published signs and symptoms of the different stages of sepsis that are available with no permission required to reuse the information. It is a one-page document that the nurse reviews and circles the stage of sepsis and then circles the symptoms the patient has or checks the section that says no criteria met.

Both proximal and distal outcomes are expected from the sepsis tool implementation (Polit & Beck, 2012). Proximal outcomes are those outcomes that occur immediately, and are directly connected to the sepsis screening tool, such as early recognition and treatment of sepsis. Distal outcomes are those outcomes related to patient morbidity and mortality as a result of the tool's use. Both proximal and distal outcomes will be summarized in the results section of the project report. According to Terry (2012), estimating reliability is how researchers determine if the tool being used is consistent and will give the same results if the research is replicated. The reliability of the sepsis screening tool is determined by the consistent use of the screening tool by the triage nurses, by their correctly following the tool based on the education they received prior to the institution of the sepsis screening tool (See Appendix A). Training and value to nurses may be attributes that lead to reliability but they are not used as measures of reliability.

Polit and Beck (2012) describe validity as a "quality criterion referring to the degree to which inferences made in a study are accurate and well-founded; in measurement, the degree to which an instrument measures what it is intended to measure" (p. 745). The validity of the sepsis screening tool is determined by whether or not the tool measured what it was intended to measure. The sepsis screening tool measured the stage of sepsis the patient is on arrival to the

ED and the nurse's interpretation of these signs and symptoms, which ensured early recognition, notification of the provider, and treatment of those patients with a positive sepsis screen. The goal of this intervention is to obtain the initial information regarding the patient, have the information validated by the provider, and according to the previously established protocol have the IV, chest x-ray, lab tests and cultures completed so that IV fluids and antibiotics can begin within an hour of the patient's arrival.

Rationale for Methods

The use of a screening tool in triage to recognize sepsis on arrival of the patient in the ED provides the nurse a quick evaluation tool, and a cue that the patient has the potential for sepsis or a related condition. The sepsis screening tool is specific for the signs, symptoms, and test results recommended by the Surviving Sepsis Campaign, which is the gold standard for evaluating the degrees of sepsis (Survivingsepsis.org, 2013). Therefore, an examination of the before and after screening tool data will provide information about the correlation between the use of the screening tool and the early recognition of sepsis by the nurse.

Tool

The sepsis screening tool measures the stage of sepsis based on the sepsis criteria from the Surviving Sepsis Guidelines from 2012 (Survivingsepsis.org). The tool also allows the researcher to analyze if the patient meets the criteria for suspected sepsis and at what stage of sepsis they present with to the ED based on objective data from the patient. The positive tools are then used to check the time from triage to treatment and if the tool showed the patient was at risk for severe sepsis.

Risks and Benefits

There is minimal to no risk involving the patients themselves as the goal is to reduce the morbidity and mortality rate of those patients who arrive in the ED with sepsis. The benefits

include a reduction in the time from the patient's arrival to initiating intravenous fluids and antibiotic thereby reducing the morbidity and mortality rate of these patients, educating the nursing staff and providers, reducing the complications that result from sepsis (Puliti, 2012). Threats involved are minimal and related to non-compliance by the nurse and therefore the possibility of missing the opportunity for early diagnosis and intervention of sepsis patients.

Procedures for Implementation

The sepsis screening tool was developed and instituted for use in the emergency department with the help of the ED director at the critical access hospital in northern Arizona. An educational presentation was done at an ED nursing staff meeting in December 2012 to discuss the importance of recognizing sepsis early and the use of the sepsis screening tool. The sepsis screening tool was presented to all ED registered nurses, and a detailed explanation of how to use the tool was provided. The researcher and the emergency department director answered all questions, and a start date for tool use was set at January 1, 2013. A follow-up staff meeting was held the end of January 2013 to discuss the importance of utilizing the sepsis screening tool on every patient that arrived in the ED when this researcher discovered that there was minimal compliance with the use of the screening tool. The actual data collection period began April 1, 2013.

The sepsis screening tools were collected monthly by the researcher and the ED patient log was reviewed monthly to ensure that a screening tool was completed on each patient that presented to the ED during that month. The charts of those patients with positive sepsis screens were then requested from medical records and each chart was reviewed for the time of triage and time to treatment in the ED. Time to treatment is based on when the ED RN initiated the previously established protocol. The time to treatment included the time of protocol

implementation which includes labs drawn including blood cultures and lactic acid, chest x-ray, intravenous fluids, and antibiotics were started.

Once this data was collected for the six month period from April 1, 2013 through September 30, 2013, it was analyzed for length of time from the patient's arrival to the ED (triage time) to time of treatment (initiation of lab draw, intravenous fluids and antibiotics) with a goal of all testing, intravenous fluids, and antibiotics initiated with one hour of arrival to the ED. The pre-implementation time frame was done from April 2012 through September 2012 by reviewing the ED logs and reviewing the medical records of those patients who presented with a chief complaint of fever, nausea and vomiting, cough, abdominal pain and any other infection related complaint including altered level of conscious that could potentially be related to sepsis. These charts were also reviewed for arrival time to ED (triage time) to treatment time (initiation of lab draw, intravenous fluids and antibiotics

Data Analysis

Descriptive statistics were used to analyze the data and describe the study variables. A Welch Two Sample t-test was used. The level of significance used was $p < 0.05$. Data was analyzed using R Statistical Software and open source statistical computing program. IRB approval was obtained from Northern Arizona University.

Initially the data was tested using two-tailed t-test, which showed unequal variances and unequal standard deviations. The Shapiro-Wilks test was done to assess for normal distribution and the F test was performed confirming unequal variances and standard deviations. As a result, the Welch Correction t-test was performed.

The Welch Two sample t-test was used because of the large population and it does not require the assumption of equal population variances (Welch, 1938). It also works better than pooled variance t-tests in situations where the two groups have different standard deviations

(Welch, 1938). The study populations for this project have both different variances and different standard deviations.

Results

Specific Results

A Welch two sample t-test was used to detect differences in the mean times (in minutes) from triage to treatment, between individuals with suspected sepsis in 2012 versus individuals with suspected sepsis in 2013. With t = 5.42 (df=238.9) and *p*-value =1.453e-07, at the significance level of 0.05, sample evidence suggests that the mean times from room to treatment between individuals with suspected sepsis in 2012 versus individuals with suspected sepsis in 2013 are statistically different. The results were consistent with the *p*-values and degrees of freedom reported by Dr. Welch in his original research (Welch, 1938). The reported mean value of the time from room to treatment for an individual with suspected sepsis in 2012 is 29.20 minutes and the mean value of the time from room to treatment for an individual with suspected sepsis in 2013 is 15.55 minutes.

Validity and Reliability of Results

The reliability of the screening tool is strong because the tool does not rely on subjective data and therefore there is little margin of differences between the nurses. Consistency of the nurses filling out the tool correctly over the six-month period of the tool's implementation demonstrated reliability. The inter-rater reliability of the triage nurse when coding was stable. The screening tool measured only what it is intended to measure, the potentially septic patients. Thus, the validity of the screening tool is also strong. The number of suspected sepsis cases that turned out not to be sepsis was represented by the difference in the number of suspected cases minus the number of confirmed sepsis cases each month.

Conclusion

Summary of Results

This research project determined if introducing a sepsis screening tool at the first point of contact with the patient in a critical access hospital will increase the recognition of sepsis by the registered nurses who triages the patient and if this early recognition will lead to a decrease in the time from triage to treatment in septic patients (See Figure 1). The researcher looked at the time from triage to treatment of the patient. The time from triage to treatment after implementing the sepsis screening tool was decreased by almost fifty percent, going from 29.2 minutes (2012) to 15.5 minutes (2013) after the tool was implemented. These results show that the use of a screening tool for sepsis in triage in the ED will reduce the time to treatment significantly thus saving lives.

The high number of suspected sepsis patients who were treated with antibiotics and then later found to not have sepsis is consistent with the sepsis research and guidelines (Dellinger, et al., 2013; Sweet, et al., 2012, Gaieski, et al., 2010). Because of the high morbidity and mortality rate associated with waiting to treat sepsis, the recommendation in the evidence-based sepsis literature is to give the first dose of antibiotic within the first hour of presentation with symptoms of sepsis regardless of confirmation (Dellinger, et al., 2013; Sweet, et al., 2012, Gaieski, et al., 2010).

Limitations

The sample population was taken from a specific geographical location. To make the research more generalizable, increasing the geographic location from which the sample is taken would be more advantageous.

The limitations of this project are the constraints of the time frame outlined to complete this research, the limited pool of patients in the rural catchment area, the loss of permanent

nursing staff resulting in an increase in the number of temporary agency nursing staff in the emergency department during the six month period in 2013 that research was being conducted.

There are no other reasons that were identified that may have contributed to the decrease in time from triage to treatment because the screening tool used only objective data that was completed by the nursing staff and the staff was educated regarding the use of the tool to address the objective data. The teaching that was provided was the first time the staff was educated about sepsis.

Clinical Implications for Practice

The impact of using the sepsis screening tool on both nursing and medical practice in the emergency department is high. By utilizing the sepsis screening tool at the first point of contact with the patient there will be a significant reduction of morbidity and mortality in those patients with sepsis (Krastins, 2012). With each hour that passes without giving antibiotics and intravenous fluids to the patient with sepsis the survival of that patient decreases by 7.6 percent (Kumar, A., et al., 2001; Puliti, 2012).

By ensuring prompt diagnosis and treatment, the use of the sepsis screening tool in the emergency department will decrease the morbidity and mortality rates for patients who present with signs and symptoms of infection that could be sepsis. It will also reduce the overall cost of treatment for septic patients by reducing the sequela of sepsis, which will benefit both the patients and the hospitals by saving money for their care.

Suggestions for Future Clinical Projects or Research

Suggestions for further research would include using the same tool in different departments of the same hospital or similar rural hospital settings, such as the medical-surgical floor or the intensive care unit. It could be generalized for use in all size facilities as well. Using the tool in different sized facilities will help to validate the tool also.

Consider using the tool and removing the laboratory values prior to its use and strictly using it in the initial triage of the patients who present with signs and symptoms of infections would be beneficial. By doing this it may lessen any confusion of the nurse as to the necessity of lab results in triage in order to determine if the patient is potentially septic. It would give the nurse the ability to determine potential sepsis by observing the patient only and not having to wait on lab results.

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Appendix A

☐ **NEGATIVE SCREEN (MEETS NO CRITERIA)**

☐ **SYSTEMIC INFLAMMATORY RESPONSE SYNDROME (SIRS) IDENTIFICATION**

- 2 or more of the following systemic inflammatory response syndrome (SIRS) criteria:
  - Heart rate > 90 beats per minute
  - Temperature < 36°C (96.8°F) or > 38.3°C (101°F)
  - Respiratory rate > 20 breaths per minute or PaCO2 <32 mmHg
  - White blood cell count > 12,000/mm3 or < 4000mm3 or a left shift in the immaturation of granulocytes (bands) > 10%

☐ **SEPSIS IDENTIFICATION**

- Documented or Suspected Source of Infection
- **AND**
- SIRS Criteria (≥ 2 meets SIRS definition)
  - Temp >38°C (100.4°F) or < 36°C (96.8°F)
  - Heart Rate > 90
  - Respiratory Rate > 20 or $PaCO_2$ < 32 mm Hg
  - WBC > 12,000/mm^3, < 4,000/mm^3, or > 10% bands
  - Hypotension, or Hypoperfusion
  - Lactic Acidosis
  - SBP <90 or SBP Drop >40 mm Hg of normal Septic Shock Criteria

☐ **SEVERE SEPSIS**: At least one of the following indicators of tissue hypoperfusion or sepsis related acute organ dysfunction:

- Acute altered mental status
- Systolic blood pressure < 90 mmHg or mean arterial pressure < 70 mmHg or a SBP decrease of 40 mmHg
- Blood glucose > 140 mg/dL in patients without diabetes.
- Arterial hypoxemia (PaO2/FiO2 < 300)
- Acute oliguria (< 0.5 ml/kg per hour for at least 2 hours)
- Creatinine increase > 0.5 mg/dL above baseline
- Coagulation abnormalities (INR > 1.5 or a PTT > 60 secs)
- Ileus
- Thrombocytopenia (platelet count, < 100,000 μL-1)
- Hyperbilirubinemia (plasma total bilirubin > 2mg/dL) Lactate > 2 mmol/L

☐ **SEPTIC SHOCK**: Severe sepsis plus refractory hypotension and perfusion abnormalities. Defined as a state of acute circulatory failure characterized by persistent arterial hypotension despite adequate fluid resuscitation or by tissue hypoperfusion (manifested by a lactate concentration greater than 4 mg/dL) unexplained by other causes.

(Adapted from Surviving Sepsis Campaign Guidelines 3rd edition 2012, survivingsepsis.org)

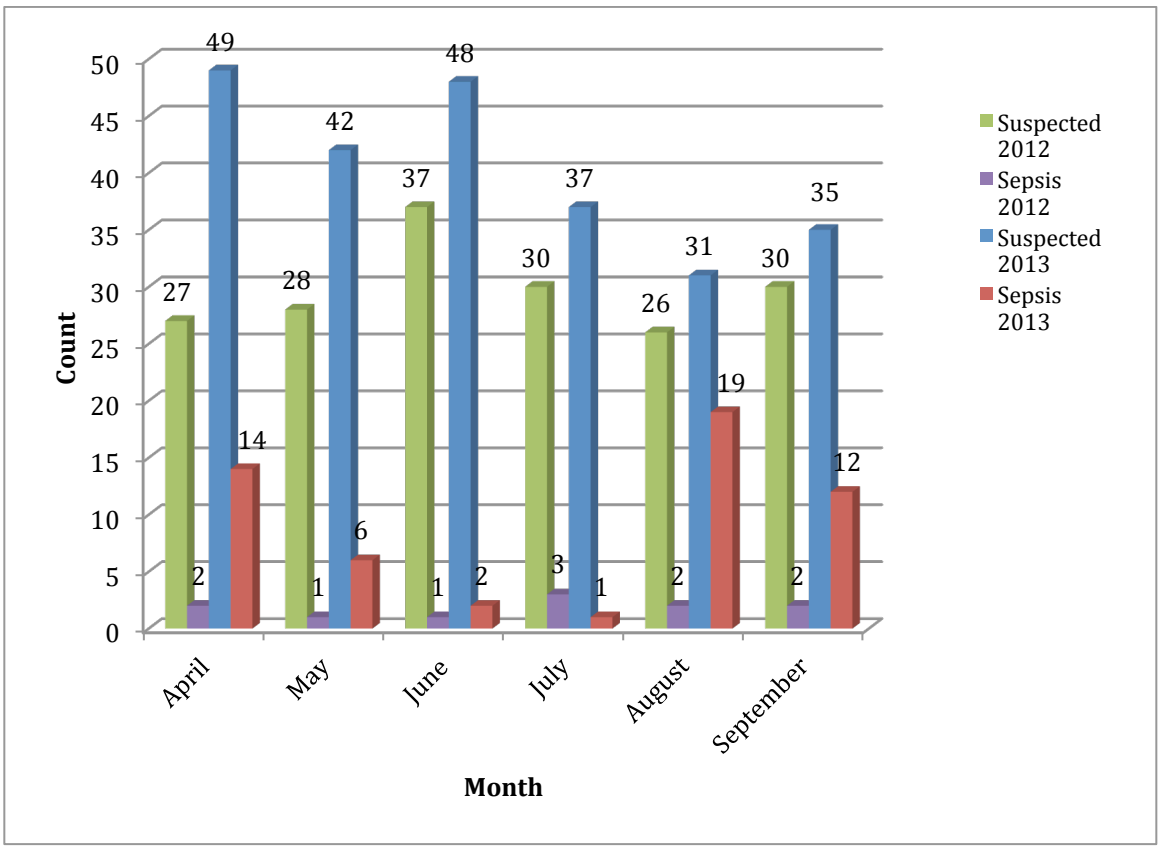

Figure 1: Comparison of monthly totals of suspected and confirmed sepsis for 2012 and 2013