ARC Journal of Nursing and Healthcare
Volume 4, Issue 1, 2018, PP 3-20
ISSN No. (Online) 2455-4324
DOI: http://dx.doi.org/10.20431/2455-4324.0401002
www.arcjournals.org

Early Recognition of Sepsis in the Emergency Department

Nycole D. Oliver*, DNP, RN, APRN, FNP-C, ACNPC-AG, CEN

Sparks Health System, 1001 Towson Ave. Fort Smith, AR 72901, University of South Alabama, 307 N. University Blvd Mobile, AL 36688

***Corresponding Author:** Nycole D. Oliver, Sparks Health System, 1001 Towson Ave. Fort Smith, AR 72901, University of South Alabama, 307 N. University Blvd Mobile, AL 36688. Email: Nycole.Oliver@yahoo.com*

Abstract

Problem Statement: *In the United States, over three-quarters of a million patients are hospitalized with sepsis each year, with a mortality rate of just over 200,000.*

Purpose: *Increase early sepsis recognition in the ED through utilization of early goal-directed therapy.*

Methods: *A retrospective chart review (pre- and post- screening tool implementation) research design was used. Subjects were chosen based on diagnosis codes placed by the emergency clinician. Inclusion criteria: patients over the age of 18 with suspected infection plus two or more systemic inflammatory response syndrome (SIRS) criteria: (a) heart rate greater than 90, (b) systolic blood pressure less than 90, (c) mean arterial pressure less than 65, (d) temperature less than 96.8◦F or above 100.5◦F, and (e) respiratory rate above 20.*

Analysis: *Paired sample t-tests and the Wilson Score Confidence Interval were used to evaluate data pre- and post- implementation.*

Results: *The data did not give sufficient evidence to conclude the screening tool decreased door to diagnosis time, door to lactate measurement, or increased the percentage of blood cultures obtained prior to antibiotic administration. The data did conclude a decrease in diagnosis to antibiotic administration.*

Significance: *A screening tool for early recognition of sepsis may lead to a decrease in door to antibiotic time.*

Keywords: *Sepsis, Screening Tool, Early Recognition, Emergency Department, Goal-Directed Therapy*

Sepsis is a systemic inflammatory response typically triggered by an infection, and is associated with hypoperfusion, hypotension, and/or organ dysfunction (Hermans, Leffers, Jansen, Keulemans, & Stassen, 2012; Burney et al., 2012). Sepsis accounts for over a half million emergency department (ED) visits each year (Hermans, et al., 2012). According to Hermans et al. (2012), one of the biggest advancements in sepsis treatment has been promotion of early goal-directed therapy (EGDT), a key component of which is early recognition in the ED.

In the United States, sepsis is in the top ten leading causes of death, with a mortality rate between forty to sixty percent (Burney et al., 2012). With over half a million annual ED visits for sepsis, the aforementioned mortality rate must be decreased. An interest by the corporate owner of a healthcare system has placed development of an early recognition protocol at the forefront of the ED director's agenda (Kelly Hill, personal communication, September 18, 2014).

In the United States, over three-quarters of a million patients are hospitalized with severe sepsis each year, with a mortality rate of just over 200,000 (Perman, Goyal, &Gaieski, 2012). Medical costs related to sepsis are approximately $17 billion annually (Seymour et al., 2012). From 2003 to 2007, the total number of sepsis cases increased by seventy-one percent, while the total hospital costs increased by fifty-seven percent (Lagu et al., 2012). Various cost analyses of initiating an early goal-directed sepsis protocol have been conducted, and have concluded a protocol is cost-effective in the long run, especially when patient mortality rates are considered (Jones, Troyer, & Kline, 2011).

To date, a major driver of early sepsis recognition is the *Surviving Sepsis Campaign (SSC)*. The SSC was initiated in 2002, and is a partnership of the European Society of Intensive Care Medicine and the Society of Critical Care Medicine (Society of Critical Care Medicine, n.d.). Many organizations who have implemented the SSC have seen a drastic decrease in mortality related to sepsis.

1. Clinical Question

The clinical question identified using the elements of population/problem, intervention, comparison, and outcome (PICO) is:*In an adult population in an ED setting, does implementation of an assessment tool for identifying sepsis patients increase early recognition of sepsis by decreasing door to diagnosis times, decreasing time of presentation to serum lactate measurement, decreasing diagnosis to antibiotic times, and increasingthe number of blood cultures being obtained before antibiotic administration?*

2. Review of Literature

The University of South Alabama'sBiomedical Library, MEDLINE, and the Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases were utilized for search of the literature. Terms used for exploration included *sepsis, early recognition of sepsis, sepsis* and *emergency department, sepsis protocol* and *emergency department, early recognition of sepsis* and *emergency department*, and *sepsis* and *early goal directed therapy*. Search dates were limited to the last 5 years, and further refinement to only articles with full-text availability was performed.

After refinement of only full-text articles within the last 5 years, there were 3,512 hits while searching *sepsis*, 15 hits with *early recognition of sepsis*,145 with *sepsis* and *emergency department*, 6 with *sepsis protocol* and *emergency department*,6 with *early recognition of sepsis* and *emergency department*, and 29 with *sepsis* and *early goal directed therapy*. Each abstract was reviewed by the DNP student to determine relevancy to the clinical question. Fifteen studies were chosen for the literature summary table (see Appendices A-C), and each article was graded and ranked.

Of the studies, three were ranked a level I (evidence from at least one well-designed randomized controlled trial), six were a level II-2 (data from well-designed cohort or case-control analytic studies, from more than one center or research groupif at all possible), and six were a level II-3 (comparisons between times or places with or without the intervention: results from uncontrolled studies). For grading, ten were graded 1C (strong; can apply to most patients in most circumstances), two were graded 2A (intermediate-strength; best action may differ depending on circumstances or patient or societal values), and two were graded 2B (weak; alternate approaches likely to be better for some patients under certain circumstances).

The literature supplies different tactics to approach early recognition of sepsis in the ED; however, the research employs the same principle: a standardized approach and early recognition protocol must be in place to recognize, diagnose, and treat sepsis in the ED in a timely manner in order to increase outcomes for the patient and decrease length of stay and subsequent hospital costs.Seven of the fifteen studies included in the literature review recommend employing a triage screening tool and/or sepsis protocol in the ED to facilitate early recognition so the patient can receive treatment sooner, and increase the chances of survival. The studies employing a screening tool and/or ED sepsis protocol for EGDT showed a significant reduction in the time of diagnosis to antibiotic time and had a subsequent decrease in mortality rates (see Appendix A).

3. Project Methodology

Subjects

Subjects were chosen based on diagnosis codes placed by the emergency clinician. Participants included ED patients at or over the age of 18 with suspected signs and symptoms of sepsis (described with *inclusion criteria* later). Participants were of different ages, various racial backgrounds, and from both genders. Inclusion criteria were patients with suspected infection such as pneumonia, skin infection, urinary tract infection, meningitis, abdominal infection, bone or joint infection, indwelling device/line, flu/viral/fungal illness *plus* two or more systemic inflammatory response syndrome (SIRS) criteria: (a) heart rate greater than 90, (b) systolic blood pressure less than 90, (c) mean arterial pressure less than 65, (d) temperature less than 96.8◦F or above 100.5◦F, and (e) respiratory rate above 20 (Appendix D). Exclusion criteria were patients who did not meet the criteria for sepsis according to a modified version of the *Surviving Sepsis Campaign*'s screening tool (Surviving Sepsis, 2013) (Appendix D).

Setting

The practice setting in which the project was implemented was a rural hospital ED in Fort Smith, Arkansas. The institution had over 154,000 patient interactions in 2011, and is growing each year (Sparks Health System, 2014). The hospital is licensed for 492 beds; the ED has 33 with the potential for 10 additional overflow beds. The ED treated over 70,000 patients in 2014. During a 12-hour shift, the ED is preferably staffed with: twelve Registered Nurses (RNs)/Licensed Practical Nurses (LPNs), two Unit Secretaries, three ED Technicians, three/four physicians/Nurse Practitioners, and twoTriage Technicians, along with subsidary staff (J. W. Kennon, personal communication, January 17, 2015).

Tools

A modification of the *Surviving Sepsis Campaign*'s data collection tool (Appendix E) best evaluated effectiveness for the student's project (Surviving Sepsis Campaign, n.d). The tool has been utilized by numerous hospitals as part of the *Surviving Sepsis Campaign* bundles and has been proven to be a valid and reliable tool in measuring each step of the process. The modified tool measured whether the patient met criteria for sepsis based on the aforementioned screening tool (Appendix D), the date and time of presentation, admission category, serum lactate measurement and time, blood culture collection and time, antibiotic administration and time, and hospital discharge date and time.

Intervention and Data Collection

To implement the project, the student identified a phenomenon of interest, performed a needs assessment, completed a literature review, established aims and outcomes for the project, provided a QI, EBP, and nursing theory model for basis of the project, and described project methodology. First, the student set up a measuring system to gather information in a 3 month retrospective chart review to determine the success of identifying patients with sepsis and determine the door to diagnosis time, the amount of time it took for a sepsis diagnosis before antibiotic administration, the time of lactate measurement, and the percentage of blood cultures obtained before antibiotic administration. Second, the student implemented a screening tool for the triage nurse to utilize to identify potential sepsis patients (with buy-in from the ED administrative staff and physicians). A process map of the screening tool is provided for review (Appendix F). Nurses, ED physicians, and ED technicians and secretaries were educated on the new screening process in shift change reports and with handouts so they were aware of the new process. Next, the student had the ED nurses utilize the new sepsis screening tool to prospectively flag sepsis patients and measured any improvement in recognition of the patient with sepsis and subsequently decrease door to diagnosis times, decrease the time from presentation to serum lactate measurement, decrease diagnosis to antibiotic times, and increase blood culture collection prior to antibiotic administration. The screening tool was utilized for a period of two months. Each patient was given an information sheet outlining the project and informing them what would be done with the information obtained during the study (Appendix G)

Next, the student did a chart review for the 2-month period of screening tool implementation to determine if the screening tool was effective in decreasing door to diagnosis times, decreasing the time from presentation to serum lactate measurement, decreasing diagnosis to antibiotic times, and increasing blood culture collection prior to antibiotic administration.

Analysis/Evaluation Plan

The student partnered with the information technology department in the institution to analyze data for the project by utilizing the paper data collection tool (Appendix E). Outcomes performance measures to determine the project's effectiveness include (a) reducing door to diagnosis times, (b) decreasing time from presentation to serum lactate measurement, (c) decreasing diagnosis to antibiotic times, and (d) increasing the number of blood cultures obtained before antibiotic administration. The student did a retrospective pre/post project implementation chart review to determine the amount of time it took for a lactate measurement and sepsis diagnosis before the screening tool compared to after the screening tool, as well as the time from diagnosis to antibiotic administration before and after implementation. The student additionally calculated the percentage of blood cultures obtained prior to initial antibiotic administration prior to and after project implementation. The overall goal of the project was to increase early sepsis recognition in the ED through utilization of early goal-directed therapy.

Paired sample t-tests were used to evaluate whether there was a reduction in door to sepsis diagnosis, door to lactate, and diagnosis to

antibiotic times pre- and post- implementation. The Wilson Score Confidence Interval was used to compare the percentage of blood cultures collected before antibiotic administration pre- and post- implementation.

4. Results and Discussion

Results

The study included 63 patients presenting to the ED before screening tool implementation, and 23 patients after implementation. There were no statistically significant differences in patient characteristics per period. Thirteen sepsis screening tools were completed in the two-month period of implementation. The data did not give sufficient evidence to conclude the screening tool decreased door to diagnosis time, door to lactate measurement, or increased the percentage of blood cultures obtained prior to antibiotic administration. The data did conclude a decrease in diagnosis to antibiotic administration (Tables 1-4).

Table1. *Significance of Door to Sepsis Diagnosis*

T TEST: Equal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One									
Tail	13.90085	0.744907	82	0.229229	1.663649			no	0.081984
Two						-			
Tail	13.90085	0.744907	82	0.458458	1.989319	17.2984	38.00806	no	0.081984
T TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One									
Tail	11.93586	0.86754	51.13845	0.194849	1.675285			no	0.120432
Two						-			
Tail	11.93586	0.86754	51.13845	0.389699	2.007584	13.6074	34.31708	no	0.120432

Table2. *Significance of Door to Lactate*

T TEST: Equal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One									
Tail	54.36254	0.906076	82	0.183775	1.663649			no	0.099562
Two						-			
Tail	54.36254	0.906076	82	0.36755	1.989319	157.401	58.88781	no	0.099562
T TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One									
Tail	71.85305	0.685519	25.2964	0.249626	1.708141			no	0.135049
Two						-			
Tail	71.85305	0.685519	25.2964	0.499251	2.059539	197.241	98.72753	no	0.135049

Table3. *Significance of Diagnosis to Antibiotic Administration*

T TEST: Equal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One									
Tail	39.44828	1.572645	82	0.059826	1.663649			no	0.171108
Two						-			
Tail	39.44828	1.572645	82	0.119652	1.989319	16.4371	140.5133	no	0.171108
T TEST: Unequal Variances				Alpha	0.05				
	std err	*t-stat*	*df*	*p-value*	*t-crit*	*lower*	*upper*	*sig*	*effect r*
One									
Tail	29.39412	2.110562	72.2102	0.019137	1.666294			yes	0.241046
Two						-			
Tail	29.39412	2.110562	72.2102	0.038274	1.993464	3.44201	120.6342	yes	0.241046

Table4. *Percentage of Blood Culture Prior to Antibiotic Administration*

Alternative Hypothesis: p1 not = p2
Pooled proportion: 0.7619048
Test Statistic, z: 0.4439

Critical z:±1.9600
P-Value:0.6571
95% Confidence interval:
-0.1663049 < p1-p2 <0.2601465
We cannot conclude that the two proportions are different at 0.05 significance level

The literature concludes sepsis outcomes can be enhanced though early recognition. The factors in this project have been studied extensively, and although the particular project did not correlate with the literature completely, with more time and data, the outcomes would likely match up.

Discussion

The quality of care for sepsis patients can be increased by a relatively simple and inexpensive method such as the proposed screening tool. To further progress care for sepsis patients and improve early recognition of patients with sepsis in the ED setting, additional improvement activities and compliance with sepsis protocols put into action are required. An electronic screening tool would perhaps be more user-friendly and convenient for the nurses, since they had to remember to pull the paper screening tool each time a patient came in.

An early screening protocol utilizing the sepsis screening tool would also be beneficial. After speaking with the ED nurses in the project implementation institution, suggestions were made to make the paper tool an electronic version and tie it into the electronic health record the hospital uses. The nurses stated if the screening tool was in the computer and made a "required" point of the triage, there would be more compliance and accuracy with the tool.

5. Limitations

The study is limited in being an uncontrolled study in a single hospital. The short time frame for screening tool implementation also limits the potential. Only 13 screening tool were utilized during the two-month period of implementation, despite the fact there were 23 sepsis patients during that period. A paper screening tool may be viewed as an inconvenience for triage nurses, thus decreasing compliance rates. According to the information technology department at the hospital where the project took place, the components of the screening tool can be incorporated into the electronic chart to prospectively flag each patient meeting the criteria for sepsis, perhaps as an option in the future.

Since only providers can order antibiotics, the responsibility of that component lies with the provider. The screening tool, however, has the potential to empower the nurses to question about the need for antibiotic therapy earlier.

6. Conclusions/Significance to Advance Nursing Practice

A screening tool for early recognition of sepsis may lead to a decrease in door to antibiotic time. Sepsis is a life-threatening condition that impacts thousands of people each year. Evidence concludes early and assertive treatment in the ED can make a difference in patient outcomes (Vanzant & Schmelzer, 2011). The student's project will make a difference in population outcomes by raising awareness of the condition early so treatment can begin in a timely manner, thus decreasing mortality rates from sepsis. The project could also impact the way care is implemented by increasing awareness of the signs and symptoms of sepsis and lessen the amount of time before action is taken.

Acknowledgements

I would like to thank the Institutional Review Board, nurses, ED providers, ED techs, ED unit assistants, and the rest of the ED staff from Sparks Health System for including the patients in the sepsis screening tool process, and for ensuring safe and effective care for sepsis patients presenting through the ED of the aforementioned institution. I would also like to thank Steward Huang, PhD for his help with statistical analysis of the project.

References

[1] Berger, T., Green, J., Horeczko, T., Hagar, Y., Garg, N., Suarez, A., … Shapiro, N. (2013). Shock index and early recognition of sepsis in the emergency department: Pilot study. *Western Journal of Emergency Medicine, 14*(2), 168-174. doi:10.5811.westjem.2012.8.11546

[2] Burney, M., Underwood, J., McEvoy, S., Nelson, G., Dzierba, A., Kauari, V., & Chong, D. (2012). Early detection and treatment of severe sepsis in the emergency department: Identifying barriers to implementation of a protocol-based approach. *Journal of Emergency Nursing, 38*(6), 512-517. doi:10.1016/ j.jen. 2011.08.011

[3] Calle, P., Cerro, L., Valencia, J., & Fabian, J. (2012). Usefulness of severity scores in patients with suspected infection in the emergency department: A systematic review. *The Journal of Emergency Medicine, 42*(4), 379-391. doi:10.1016/j/jemermed.2011.03.033

[4] DiCenso, A., Guyatt, G., &Ciliska, D. (2005). *Evidence-based nursing: A guide to clinical practice* (pp 166 & 519). St. Louis, MO: Mosby

[5] Hermans, M. A., Leffers, P., Jansen, L. M., Keulemans, Y. C., & Stassen, P. M. (2012). The value of the Mortality in Emergency Department Sepsis (MEDS) score, C reactive protein and lactate in predicting 28-day mortality of sepsis in a Dutch emergency department. *Emergency Medicine Journal, 29*(4), 295-300. doi:10.1136/emj.2010.109090

[6] Jones, A. E., Troyer, J. L., & Kline, J. A. (2011). Cost-effectiveness of an emergency department based early sepsis resuscitation protocol. *Critical Care Medicine, 39*(6), 1306-1312. doi:10.1097/CCM.0b01 3e31821201be

[7] Judd, W. R., Stephens, D. M., & Kennedy, C. A. (2014). Clinical and economic impact of a quality improvement initiative to enhance early recognition and treatment of sepsis. *Annals of Pharmacotherapy, 48*(10), 1269-1275. doi:10.1177/1060028014541792

[8] Lagu, T. Rothberg, M. B., Shieh, M., Pekow, P. S., Steingrub, J. S., &Lindenauer, P. K. (2012). Hospitalizations, costs, and outcomes of severe sepsis in the United States 2003 to 2007. *Critical Care Medicine, 40*(3), 754-761. doi:10.1097/ccm.0b013e318232db65

[9] Kent, N., & Fields, W. (2012). Early recognition of sepsis in the emergency department: An evidence-based project. *Journal of Emergency Nursing, 38*(2), 139-143. doi:10.1016/j.jen.2010.07.022

[10] Nguyen, H. B., Ginkel, C. V., Batech, M., Banta, J., & Corbett, S. W. (2012). Comparison of Predisposition, Insult/Infection, Response, and Organ dysfunction, Acute Physiology And Chronic Health Evaluation II, and Mortality in Emergency Department Sepsis in patients meeting criteria for early goal-directed therapy and the severe sepsis resuscitation bundle. *Journal of Critical Care, 27*(4), 362-369. doi:10.1016/j.jcrc.2011.08.013

[11] Patocka, C., Turner, J., Xue, X., & Segal, E. (2014). Evaluation of an emergency department triage screening tool for suspected severe sepsis and septic shock. *Journal for Healthcare Quality, 36*(1), 52-61. doi:10.1111/jhq.12055

[12] Perman, S. M., Goyal, M., &Gaieski, D. F. (2012). Initial emergency department diagnosis and management of adult patients with severe sepsis and septic shock. *Scandinavian Journal of Trauma, Resuscitation, and Emergency Medicine, 20*(41), 1-11. doi:10.1186/1757-7241-20-41

[13] Puskarich, M. A., Illich, B. M., & Jones, A. E. (2014). Prognosis of emergency department patients with suspected infection and intermediate lactate levels: A systematic review. *Journal of Critical Care, 29*(3), 334-339. doi:10.1016/j.jcrc.2013.12.017

[14] Schaub, N., Boldanova, T., Noveanu, M., Arenja, N., Hermann, H., Twerenbold, R., … Mueller, C. (2014). Incremental value of multiplex real-time PCR for the early diagnosis of sepsis in the emergency department. *Swiss Medical Weekly, 144*(11), 1-10. doi:10.4414/smw.2014.13911

[15] Seymour, C. W., Rea, T. D., Kahn, J. M., Walkey, A. J., Yealy, D. M., & Angus, D. C. (2012). Severe sepsis in pre-hospital emergency care: Analysis of incidence, care, and outcome. *American Journal of Respiratory and Critical Care Medicine, 186*(12), 1264-1271. doi:10.1164/rccm.201204-07130C

[16] Society of Critical Care Medicine. (n.d.). *About the Surviving Sepsis Campaign.* Retrieved from http://www.survivingsepsis.org/About-SSC/Pages/default.aspx

[17] Sparks Health System. (2014). *Mission, vision, and values.* Retrieved from http:// www. sparks health.com/ about/mission

[18] Surviving Sepsis Campaign (n.d.) *Severe sepsis chart review data collection tool for educational purposes.* Retrieved from http:// www.survivingsepsis.org/SiteCollectionDocuments/Data-Collection-Surviving-Sepsis.pdf

[19] Surviving Sepsis Campaign (2013). *Evaluation of severe sepsis screening tool.* Retrieved from http://www.survivingsepsis.org/SiteCollection Documents/ScreeningTool.pdf

[20] Tipler, P. S., Pamplin, J., Mysliwiec, V., Anderson, A., & Mount, C. A. (2013). Use of a protocolized approach to the management of sepsis can improve time to first dose of antibiotics. *Journal of Critical Care, 28*(2), 148-151. doi:10.1016/j.jcrc.2012.08.021

[21] Tromp, M., Hulscher, M., Bleeker-Rovers, C. P., Peters, L., van den Berg, D. T., Borm, G. F., … Pickkers, P. (2010). The role of nurses in the recognition and treatment of patients with sepsis in the emergency department: A prospective before-and-after intervention study. *International Journal of Nursing Studies, 47*(12), 1464-1473. doi:10.1016/ j.ijnurstu. 2010.04.007

[22] Turi, S. K., & Von Ah, D. (2013). Implementation of early goal-directed therapy for septic patients in the emergency department: A review of the literature. *Journal of Emergency Nursing, 39*(1), 13-19. doi:10. 1016/j/jen.2011.06.006

[23] Vanzant, A. M., &Schmelzer, M. (2011). Detecting and treating sepsis in the emergency department. *Journal of Emergency Nursing, 37*(1), 47-54. doi:10.1016/j.jen.2010.06.020

[24] Zhao, Y., Li, C., & Jia, Y. (2013). Evaluation of the Mortality in Emergency Sepsis score combined with procalcitonin in septic patients. *American Journal of Emergency Medicine, 31*(7), 1086-1091. doi:10.1016/j.ajem. 2013. 04.008

APPENDIX A

Literature Review Summary Table

Year	Author Title Journal	Purpose	Design/Sample	Results/ Recommendations	Limitations	Level/ Grade
2013	Berger, T., Green, J., Horeczko, T., Hagar, Y., Garg, N., Suarez, A., … Shapiro, N. Shock index and early recognition of sepsis in the emergency department: Pilot study. Western Journal of Emergency Medicine	To compare the ability of shock index (SI), individual vital signs, and the systemic inflammatory response syndrome (SIRS) criteria to predict the primary outcome of hyperlactatemia (serum lactate ≥ 4.0 mmol/L) as a surrogate for disease severity, and the secondary outcome of 28-day mortality.	Cohort study	SI performed as well as SIRS in negative predictive value and was the most sensitive screening test for hyperlactatemia and 28-day mortality. SI was the most specific predictor of both outcomes.	Data were collected via retrospective computerized chart review. Concurrent medication information was not collected, and any potential influence of meds on vital signs was not controlled. The cohort was elderly, with a mean age of 73 years.	II-2 1C
2012	Calle, P., Cerro, L., Valencia, J., & Fabian, J. Usefulness of severity scores in patients with suspected infection in the emergency department: A systematic review. The Journal of Emergency Medicine	To establish the accuracy of score systems in the prediction of mortality in patients with suspected infection in hospital settings compared to the ICU.	Systematic review	21 studies were included, 19 of which were carried out in the ED. The reviewed literature did not provide enough evidence to assess the accuracy of the prognostic models in patients with suspected infection admitted to the ED and hospital ward. Some reports suggested better accuracy with new scores like the MEDS, but the results are not consistent.	Only the PubMed database was utilized. Only articles in the English language were utilized.	I 2B
2012	Hermans, M. A., Leffers, P., Jansen, L. M., Keulemans, Y. C., & Stassen, P. M.	To validate the Mortality in Emergency Department Sepsis (MEDS) score as a predictor of 28-day	Cohort Study	The MEDS score was found to be a good risk stratification tool in ED patients with sepsis who are treated by an internist.	The notes of the attending doctors were depended on for the necessary info for the study.	II-2 1C

Year	Author Title Journal	Purpose	Design/Sample	Results/ Recommendations	Limitations	Level/ Grade
	The value of the Mortality in Emergency Department Sepsis (MEDS) score, C reactive protein and lactate in predicting 28-day mortality of sepsis in a Dutch emergency department. Emergency Medicine Journal	mortality rate in ED patients with sepsis in the Netherlands. To compare the MEDS score performance to C reactive protein and lactate.		The MEDS score is a good predictor of mortality and is particularly feasible in the ED setting, as all items are readily available. Discriminative ability of CRP was poor. Discriminative ability of lactate level was fair. MEDS score could be improved by combing with lactate levels.	Judgment about life expectancy was made retrospectively based on the patient records. The death rate was dependent on the severity of the disease at the moment of presentation to the ED and on decisions about treatment. The influence of sepsis on mortality may extend further than the first 28 days.	
2014	Judd, W. R., Stephens, D. M., &Kennedy, C. A. Clinical and economic impact of a quality improvement initiative to enhance early recognition and treatment of sepsis Annals of Pharmacotherapy	To evaluate the clinical and economic impact of a sepsis quality improvement initiative to improve early recognition and treatment of sepsis.	Retrospective observational study	Nonsignificant decreases in LOS and in-hospital mortality were observed in patients with sepsis. Early recognition and treatment contributed to significant reductions in ICU LOS and total cost per case. Strategies to improve early recognition and treatment of sepsis, including routine use of an electronic sepsis screening tool and implementation of a first dose STAT antibiotic policy, contributed to significant reductions in ICU LOS and cost per case.	The retrospective quality of the study can cause significant limitations. Septic patients were identified using DRGs, which rely on the accuracy of the individual coder and require accurate documentation to determine the principal diagnosis.	II-3 1C

Year	Author Title Journal	Purpose	Design/Sample	Results/ Recommendations	Limitations	Level/ Grade
2012	Kent, N., & Fields, W. Early recognition of sepsis in the emergency department: An evidence-based project Journal of Emergency Nursing	To implement a sepsis screening measure for improving the identification, communication, , and treatment of patients with sepsis.	Evidence-based project	Utilization of a sepsis screening measure increases recognition of a small number of patients who present to the ED with severe sepsis. Hospitals should benefit from utilizing a nurse-based screening measure to recognize severe sepsis, thus guiding nursing and medical care.	This project is limited in that it was only implemented at one hospital for a short period of time. There were a low number of patients in the study who actually screened positive for severe sepsis, further limiting the study.	II-3 2B
2012	Nguyen, H. B., Ginkel, C. V., Batech, M., Banta, J., & Corbett, S. W. Comparison of Predisposition, Insult/Infection, Response, and Organ dysfunction, Acute Physiology And Chronic Health Evaluation II, and Mortality in Emergency Department Sepsis in patients meeting criteria for early goal-directed therapy and the severe sepsis resuscitation bundle.	To examine the performance of the Predisposition, Insult/Infection, Response, and Organ dysfunction (PIRO) model compared with the Acute Physiology and Chronic Health Evaluation (APACHE) II and Mortality in Emergency Department Sepsis (MEDS) scoring systems in predicting in-hospital mortality for patients presenting to the emergency department (ED) with severe sepsis or septic shock.	Cohort study	In this patient cohort, PIRO performed equally well when compared with APACHE II and surpassed MEDS in discriminating survivors from nonsurvivors. PIRO was less time- consuming to compute compared with APACHE II and MEDS scores.	The authors were limited to scores that were already entered in an existing registry over 6 years. The authors accepted the existing literature that there would be inter- and intra-observer variability in computing the scores and that such variability may lead to misclassification of a patient's severity. The authors found some limitations to the APACHE II score, which could give variable results.	II-2 1C

Year	Author Title Journal	Purpose	Design/Sample	Results/ Recommendations	Limitations	Level/ Grade
	Journal of Critical Care					
2014	Patocka, C., Turner, J., Xue, X., & Segal, E. Evaluation of an emergency department triage screening tool for suspected severe sepsis and septic shock. Journal for Healthcare Quality	To determine the effect of a triage screening tool on time to antibiotics in patients with severe sepsis or septic shock presenting to the ED.	Retrospective pre/post chart review	After implementation of the triage assessment tool, mean time to antibiotics decreased by 21%. Sixty-four percent of the patients who qualified for the study were appropriately identified and had the triage sheet filled out appropriately post-implementation. Despite only moderate adherence (64%), the implementation of a sepsis screening tool at triage appears to have significantly decreased the time from triage to antibiotic administration in patients presenting with suspected severe sepsis or septic shock.	The pre/post chart review has a potential for bias and unrecorded cofounders. The retrospective nature of the study design makes it difficult to establish casualty between the results obtained and the implementation of the sepsis protocol. The authors' definitions of suspected severe sepsis and septic shock could be questioned, especially since in their criteria, they did not specify how the temperature of the patient should be measured. Some, but not all were measured orally.	II-3 2A
2014	Puskarich, M. A., Illich, B. M., & Jones, A. E. Prognosis of emergency department patients with suspected	To quantify the prognostic significance of intermediate blood lactate levels in ED patients with suspected infection,	Systematic review	8 studies were included. Among ED patients with suspected infection, intermediate lactate elevation is associated with a moderate to high	Conference abstracts and other unpublished data from the "gray" literature were not identified.	I 1B

Year	Author Title Journal	Purpose	Design/Sample	Results/ Recommendations	Limitations	Level/ Grade
	infection and intermediate lactate levels: A systematic review. Journal of Critical Care	emphasizing patients without hypotension.		risk of mortality, even among patients without hypotension. Physicians should be aware of the poor prognosis of this group of patients, should monitor them closely, and give more consideration to more aggressive treatment to prevent further progression to shock or death.		
2014	Schaub, N., Boldanova, T., Noveanu, M., Arenja, N., Hermann, H., Twerenbold, R., … Mueller, C. Incremental value of multiplex real-time PCR for the early diagnosis of sepsis in the emergency department. Swiss Medical Weekly	To assess the diagnostic accuracy of blood cultures and PCR in adult patients presenting to the ED with suspected sepsis.	Cohort study	The diagnostic accuracy of PCR in detecting sepsis and its causative organism was comparable to that of blood cultures. The additional use of PCR significantly reduced time to microbiological diagnosis as compared to the use of conventional use of microbiological methods alone. PCR does not offer broad susceptibility testing, and can only be used as an adjunct method to blood cultures at this time.	PCR may potentially lead to detection of bacteremia and fungaemia due to translocation from naturally colonizes surfaces and even non-replicating bacteria. The cohort was very small, with 110 patients; 79 with sepsis and only 36 with positive cultures.	II-2 1C
2013	Tipler, P. S., Pamplin, J., Mysliwiec, V., Anderson, A., & Mount, C. A. Use of a protocolized approach to the management of sepsis can improve time to first dose	To determine if a sepsis protocol improved the time to first dose of antibiotics in patients diagnosed with sepsis.	Retrospective chart review	The average time to first dose of antibiotics for the presepsis protocol group was 160 minutes, and for the sepsis protocol group was 99 minutes. Initiation of a sepsis protocol, which emphasizes early goal-directed therapy, can improve time to	Limitations inherent to a retrospective examination of various data are present. The study was not designed in a manner that allowed for detecting a difference in outcomes of	II-3 1C

Year	Author Title Journal	Purpose	Design/Sample	Results/ Recommendations	Limitations	Level/ Grade
	of antibiotics. Journal of Critical Care			administration of first dose of antibiotics.	patients treated for sepsis before and after the protocol was initiated.	
2010	Tromp, M., Hulscher, M., Bleeker-Rovers, C. P., Peters, L., van den Berg, D. T., Borm, G. F., … Pickkers, P. The role of nurses in the recognition and treatment of patients with sepsis in the emergency department: A prospective before-and-after intervention study. International Journal of Nursing Studies	To determine the effects of a multifaceted implementation program including the introduction of a nurse-driven, care-bundle based, sepsis protocol followed by training and performance feedback.	Prospective before-and-after intervention study	Compliance with the complete bundle significantly improved from 3.5% at baseline to 12.4% after the implementation program was put into place. The mean number of performed bundle elements improved significantly from 3.0 elements at baseline to 4.2 elements after intervention. Using a nurse-driven, care bundle based, sepsis protocol followed by training and performance feedback results in improved early recognition and treatment of patients with sepsis who present to the ED. More attention should be given to the role of nurses in quality of improvement of sepsis care.	Was an uncontrolled study in a single center. Results cannot be extrapolated since the program was tailor-made to the situation of the hospital. The clinical signs included in the sepsis screening list are very sensitive, but not very specific.	II-3 1C
2013	Turi, S. K., & Von Ah, D Implementation of early goal-directed therapy for septic patients in the emergency department:	To review the literature regarding the implementation of the sepsis guidelines in emergency departments.	Systemic review	Studies that discussed collaboration, preplanning, and education were able to implement monitoring of central venous pressure, mean arterial pressure, and central venous oxygen saturation.	Studies reviewed were limited by their design, setting/sample, and length of follow-up. No RCTs or meta-analysis were identified in	I 1C

Year	Author Title Journal	Purpose	Design/Sample	Results/ Recommendations	Limitations	Level/ Grade
	A review of the literature. Journal of Emergency Nursing			Nursing interventions recommended by the Surviving Sepsis Campaign such as measuring urine output and obtaining blood cultures were less often considered. More research is needed to overcome barriers to implementing early goal-directed therapy and to uncover which elements are most important and feasible to achieve optimal patient outcomes.	the search. All studies were in single EDs. Studies reviewed had lack of discussion as to how to keep and maintain the momentum of using the sepsis guidelines after an initial implementati on.	
2013	Zhao, Y., Li, C., & Jia, Y. Evaluation of the Mortality in Emergency Sepsis score combined with procalcitonin in septic patients. American Journal of Emergency Medicine	To determine an effective method for predicting severity of sepsis and 28-day mortality of ED patients, comparing the MEDS score with procalcitonin, interleukin-6 (IL-6), and C-Reactive protein (CRP), and to evaluate the MEDS score combined with relevant biomarkers.	Prospective study	The new combination of the MEDS score with PCT improved the area under the curve for severity and mortality. This new combination had better sensitivity, specificity, and positive predicative and negative predicative values. The predictive ability of the MEDS score for severity and 28-day mortality of septic ED patients is better than the PCT, IL-6, and CRP levels. The MEDS score combined with PCT enhances the ability of risk stratification and prognostic evaluation.	PCT, IL-6, and CRP rises, peaks, and plateaus were different among biomarkers. Only 1 biomarker concentration was obtained at the time of ED evaluation instead of at serial time points. All patients in the study were nonoperative septic patients from the ED resuscitation room, not all ED sepsis patients which limited the sample size.	II-2 2A

Note: Levels modified from:

DiCenso, Guyatt, & Ciliska and the Canadian Task Force on Preventive Health Care Levels of Evidence and Grades of Recommendations (p 519)

Grades derived from: DiCenso, Guyatt, & Ciliska (p 166)

APPENDIX B

Levels of Evidence Modified from DiCenso, Guyatt, & Ciliska and the Canadian Task Force on Preventive Health Care Levels of Evidence (p 519)

Level	Explanation
I	Evidence from at least one well-designed randomized controlled trial
II-1	Evidence from well-designed controlled trials without randomization
II-2	Evidence from well-designed cohort or case-control analytic studies, preferably from more than one center or research group
II-3	Evidence from comparisons between times or places with or without the intervention: results from uncontrolled studies could be included here
III	Opinions of respected authorities, based on clinical experience; descriptive studies or reports of expert committees

APPENDIX C

Grades of Evidence Derived from: DiCenso, Guyatt, & Ciliska (p 166)

Grade of Recommendation	Balance Between Benefits and Risks	Methodological Strength of Supporting Evidence in Systematic Reviews	Implications
1A	Clear	RCTs without important limitations	Strong recommendation; can apply to most patients in most circumstances without reservation
1B	Clear	RCTs with important limitations (inconsistent results, methodological flaws)	Strong recommendation; likely to apply to most patients in most circumstances
1C+	Clear	No RCTs directly addressing the question, but results from closely related RCTs can be unequivocally extrapolated, or evidence from observational studies may be overwhelming	Strong recommendation; can apply to most patients in most circumstances
1C	Clear	Observational studies	Intermediate-strength recommendation; may change when stronger evidence is available
2A	Unclear	RCTs without important limitations	Intermediate-strength recommendation; best action may differ depending on circumstances or patient or societal values
2B	Unclear	RCTs with important limitations(inconsistent results, methodological flaws)	Weak recommendation; alternative approaches likely to be better for some patients under some circumstances
2C	Unclear	Observational studies	Very weak

			recommendation;
			other alternatives may be
			equally reasonable

APPENDIX D

Evaluation for Severe Sepsis Screening Tool

Instructions: Use this optional tool to screen patients for severe sepsis in the emergency department, on the medical/surgical floors, or in the ICU.

1. Is the patient's history suggestive of a new infection?

Pneumonia, empyema
Urinary tract infection
Acute abdominal infection
Meningitis
Skin/soft tissue infection
Bone/joint infection
Wound infection
Blood stream catheter infection
Endocarditis
Implantable device infection
Other infection
_____

___ Yes ___No

2. Are any two of following signs & symptoms of infection both present and new to the patient? Note: laboratory values may have been obtained for inpatients but may not be available for outpatients.

Hyperthermia > 38.3 °C (101.0 °F)
Hypothermia 36 °C (96.8°F)
Altered mental status Tachycardia > 90 bpm
Tachypnea > 20 bpm
Leukocytosis (WBC count >12,000 µL–1)
Leukopenia (WBC count <4000 µL–1)
Hyperglycemia (plasma glucose >140 mg/dL) or 7.7 mmol/L in the absence of diabetes

___ Yes ___No

If the answer is yes, to both questions 1 and 2, *suspicion of infection* is present:

Ask physician about obtaining: **lactic acid**, **blood cultures**,

At the physician's discretion obtain: CBC with differential, basic chemistry labs, bilirubin, UA, chest x-ray, amylase, lipase, ABG, CRP, CT scan.

3. Are any of the following organ dysfunction criteria present at a site remote from the site of the infection that are NOT considered to be chronic conditions? Note: in the case of bilateral pulmonary infiltrates the remote site stipulation is waived.

SBP < 90 mmHg or MAP <65 mmHg

SBP decrease > 40 mm Hg from baseline

Creatinine > 2.0 mg/dl (176.8 mmol/L) or urine

output < 0.5 ml/kg/hour for 2 hours Bilirubin > 2 mg/dl (34.2 mmol/L)

Platelet count < 100,000 µL

Lactate > 2 mmol/L (18.0 mg/dl)

Coagulopathy (INR >1.5 or aPTT >60 secs)

Acute lung injury with PaO2/FiO2 <250 in the absence of pneumonia as infection source

Acute lung injury with PaO2/FiO2 <200 in the presence of pneumonia as infection source

___ Yes ___No

If *suspicion of infection* and *yes* or *no* to severe organ dysfunction criteria, ask physician about starting a broad-spectrum antibiotic

APPENDIX E

Severe Sepsis Chart Review data collection tool for educational purposes

Based on the Evaluation for Severe Sepsis Screening Tool

- Does the patient history suggest a new infection? If yes,
- Does the patient present with two or more new signs or symptoms of infection? If yes,
- Does the patient have evidence of organ dysfunction due to the infection?

1. Met Criteria for Severe Sepsis
2. Determine the date and time of presentation ___/___/___ ___:___

• Time of presentation is equal to ED triage time or documentation (date and time) supporting the diagnosis of severe sepsis in the progress notes for non-ED admissions.

3. Admission Category:

ED Transferred to Critical Care Unit from unit other than ED Currently in the ICU

Patients on the floor/unit outside the ED, enter date and time of last sepsis screen ___/___/___ ___:___

Hospital Admission ___/___/___ ___:___ Critical Care Unit admission ___/___/___ ___:___

Check if completed, proceed to enter date, time, and Y/N as appropriate

4. Measure serum lactate ___Yes _____mmol/L mg/dl ___/___/___ ___:____ ___No

5. Obtain blood cultures prior to antibiotic administration ___Yes ___/___/___ ___:____ ___No

Collected before the patient was started on an antibiotic for a suspected infection other than severe sepsis and continued until the time of presentation

6. Administer broad-spectrum antibiotic,

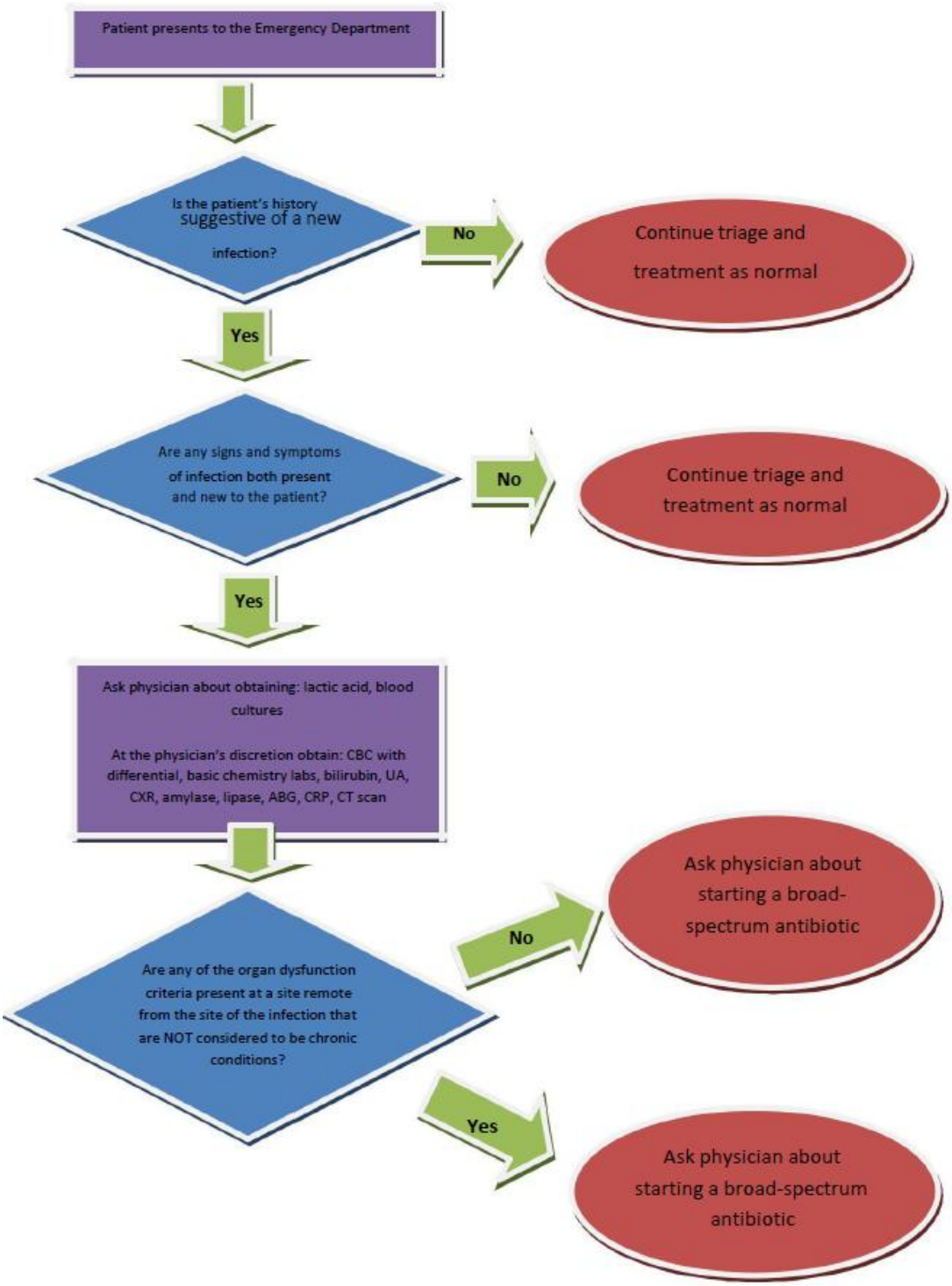
1. _____ ___/___/___ ___:____ 2._____ ___/___/___ ___:____

A broad spectrum antibiotic was initiated for a suspected infection other than severe sepsis and continued until the time of presentation with severe sepsis

Hospital Discharge ___/___/___ ___:____ Status Alive Deceased

APPENDIX F

Process Flow Map



APPENDIX G

Patient Information Sheet

Early Recognition of Sepsis in the Emergency Department Nycole Oliver, BSN, RN, CEN, DNPc

ndo1102@jagmail.southalabama.edu

You arrived in to the Emergency Department (ED) with suspected signs and symptoms of sepsis. A study is being conducted to increase early recognition of sepsis, which is a systemic inflammatory response system typically triggered by an infection, and is associated with many other illnesses.

Sepsis accounts for over a half million ED visits each year. One of the biggest advancements in sepsis treatment has been promotion of early goal-directed therapy (EGDT), a key component of which is early recognition in the ED.

The purpose of the study is to increase early recognition of sepsis in the Emergency Department. A screening tool is being utilized that will assist with early recognition of sepsis as soon as a patient arrives in the Emergency Department. The data collected from this screening tool will be used to determine the length of time between arrival, the diagnosis of sepsis and the start of treatment. The goal of this study is to ensure that all patients who have the diagnosis of sepsis will receive the start of treatment within three hours.

The information about your diagnosis will remain anonymous and no identifying data will be collected. All data will be kept for 5 years after completion of the project; and then shredded.

The data collected is anonymous and cannot be linked to you in any way. The benefit of collecting this information may assist the Emergency Department in developing new screening methods.

Please contact me at ndo1102@jagmail.southalabama.edu, the Institutional Review Board at the University of South Alabama at (251) 460-6308, or the Institutional Review Board at Sparks Regional Medical Center at (479) 441-5345 if you have additional questions.

Citation: *Nycole D. Oliver. Early Recognition of Sepsis in the Emergency Department, ARC Journal of Nursing and Healthcare. 2018; 4(1): 3-20. doi: dx.doi.org/ 10.20431/2455-4324.0401002.*