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IDENTIFYING AND ASSESSING PATIENT'S SEPSIS BY NURSES IN AN EMERGENCY DEPARTMENT: A Literature Review

ABSTRACT

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The purpose of this study was to analyze how nurses identify patient's sepsis and how nurses conduct the assessment procedure of patient with sepsis in an emergency department. The practical goal of this study was to gain knowledge on early recognition of sepsis by the nurses that they can provide evidence-based care and prompt sepsis treatment to reduce poor outcomes. The resulting knowledge was targeted to raise awareness among ED nurses, health professionals and nursing students about identifying sepsis.

The research was conducted as a literature review with both meta-synthesis and meta-analysis. Strict inclusion and exclusion criteria were constructed to secure the quality of the data. The data was collected from different databases such as EBSCO, Sage Premier, Ovid, Science Direct and Google Scholar. The selected materials were published in the restricted time frame from 2011 to present date. The total number of included articles were 16 (9 related to the qualitative method and 7 relate to the quantitative method).

The results were divided into the two subheadings, which were sepsis identification and assessment tool according to the meta-synthesis and sepsis identification and assessment procedure according to the meta-analysis. The core findings of the study was to adhere nurses with the diagnosis criteria of sepsis, sepsis screening tool and sepsis care bundles based on Surviving Sepsis Campaign guideline for the identification of sepsis along with its assessment procedure.

Key words Assessing, emergency department, identifying, nurse, sepsis

LIST OF ABBREVIATIONS

BP	Blood pressure
CAM	Confusion Assessment Method
CBC	Complete Blood Count
CNS	Central venous system
CRP	C-reactive Protein
ED	Emergency Department
ER	Emergency Room
EWS	Early Warning Score
ICUs	Intensive Care Units
NEWS	National Early Warning Score
NOrF	National Outreach Forum
MRSA	Methicillin-resistance Staphylococcus aureus
MEWS	Modified Early Warning Score
PSAG	Patient Status at a Glance
PARS	Patient at Risk Scores
RRAILS	Rapid Response to Acute Illness
SaO_2	Oxygen Saturation
SBAR	Situational Background Assessment Recommendation
$ScVO_2$	Central Venous Oxygen Saturation
SOAP	Sepsis Occurrence in Acute ill Patient
SIRS	Systemic Inflammatory Response Syndrome
SpO_2%	Saturation Pulse Oximeter in percentage
SSC	Surviving Sepsis Campaign
UK	United Kingdom
USA	United States of America
UTI	Urinary Tract Infection
WBC	White Blood Cell

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1 INTRODUCTION

Sepsis is one of the important health issues growing in the emergency department (ED). It is commonly seen in the ED as emergency cases first arrive in this unit. Depending on the patients' situation, they are transferred to intensive care units (ICUs) or other hospital wards to continue their treatment or can keep patients in the ED for further observation and diagnosis. In Finland, the incidence of severe sepsis was lower than USA, Europe or Australia, which was 0.38 per 1000 of the adult population (Karlsson 2009, 62-75).

Furthermore, the main reasons why the Finland had such a low incidence rate of severe sepsis were easily accessible to Finnish health care system with the health centre and general hospital and early treatment of infections. In 2014, Finland had 1342 cases of Methicillin-resistance Staphylococcus aureus (MRSA) that was continuously increasing rapidly. Nevertheless, in 2015 the number of MRSA cases was decreased by 67 and the total number was 1275. (Terveyden ja Hyvinvoinnin Laitos 2015.) According to the Sepsis Occurrence in Acute ill Patient (SOAP) study, 25% of septic patients had severe sepsis in Scandinavia, whereas in the UK and Ireland was 45% (Karlsson 2009, 75).

Sepsis is the 10th leading causes of death worldwide more than breast and bowel cancer. In the UK, severe sepsis accelerated about 37,000 deaths per year. Even though there were various campaigns and availability of the evidence-based treatment, the mortality rate associated with sepsis remained still high. This condition occurs mainly due to limited awareness of the sepsis among health personnel and poor identification with delayed interventions. (McClelland & Moxon 2014, 16.) In the United States, the mortality rate of sepsis ranges from 15% to 30% and predicts the average yearly incidence of sepsis could be over 3 million despite having their optimum treatment. (Miller, Capan, Jackson & Arnold 2015, 556).

Similarly, in the developing countries, sepsis was increasing more than in developed countries. Furthermore, they were unnoticed and there was too little knowledge in identifying sepsis signs and symptoms even among physicians and nursing staffs. Thus, recognition of sepsis must be a first and foremost priority among health workers especially the nurses as

they were the frontlines, who interact with the patient in all parts of the health world that enable to treat sepsis successfully. (World Sepsis Declaration 2014.)

The significant cause for a high morbidity and mortality rate of sepsis was poor identification due to its diverse signs and symptoms, which results in its delayed treatment. In addition, patients admitted at the ED were initially presented with severe sepsis but it was undiagnosed and unrecognized by ED nurses and late diagnosed by ED physicians. Therefore, early and accurate recognition are main key for initiation of treatment of sepsis such as antibiotics therapy and hemodynamic cardiac output optimization. Moreover, the time-sensitive and susceptibility nature of sepsis rapidly progress to life-threatening condition or may cause death. If root causes are tackled in the systematic ways by ED nurses to recognize sepsis, the patients' survivals are higher. This fact arose interest in the author to act on recognition and assessment of sepsis in the emergency department.

This research purpose was to analyze how nurses identify patient's sepsis and how nurses conduct the assessment procedure in the patient with sepsis in the ED. The practical goal of this study was to gain knowledge on early recognition of sepsis by the nurses that they can provide evidence-based care and prompt sepsis treatment to reduce poor outcomes. The resulting knowledge was targeted to raise awareness among ED nurses, health professionals and nursing students about identifying sepsis.

2 FOUNDATION OF THE STUDY

The foundation of the study describes the main concepts of this thesis which include a definition of sepsis, identification and assessment of sepsis and general view of nurses working in the emergency department.

2.1 Sepsis

Prior to sepsis term, the definition of Systemic Inflammatory Response Syndrome (SIRS) is meaningful to know. For instance, if the patient has developed an infection, it means the body's natural defense mechanism automatically leads to recovery the process by provoking a balanced inflammatory response. But if the responses are imbalanced and unable to stop the local infection that results microbes to enter in the circulatory system and may cause death. The imbalanced responses are called SIRS. (Woodrow 2012, 319.) Thus, SIRS can be identified with SIRS diagnostic criteria, which consists of both physiological and laboratory criteria since 1991 international consensus conference. The diagnostic criteria for SIRS are temperature > 38.3 or < 36 ^{0}C, heart rate > 90 beats/min, respiratory rate >20/min, white blood cell (WBC) count < 4,000/µL or > 12,000/µL, acutely altered mental status and hyperglycaemia (glucose > 6.6 mmol/l or 120 mg/dl) unless diabetic. (Woodrow 2012, 319; Daniels & Nutbeam 2009, 5-7.)

Sepsis, septicemia or blood poisoning all mean the same and identified as a bloodstream infection. Sepsis is a serious life-threatening complication of infection and often fatal. It is not developed on its own but stems from other medical conditions like an infection in the lungs, liver, urinary tract, abdomen, tooth, skin or any body parts. The term sepsis can be defined as a presence or presumed or confirmed presence of an infectious source in the blood such as bacteria, fungi or virus that are accompanied by evidence of at least two or more SIRS diagnostic criteria. Hence, SIRS plus presence of a known or suspected infection develops sepsis. Graph 1 illustrates the continuum of sepsis. (Tazbir 2012, 206; Johnston & Knight 2012, 29.)

Furthermore, if the patient's clinical symptoms and signs of sepsis are unnoticed and undi-agnosed, then the internal organs such as heart, lungs and kidneys are affected and start deteriorating to complete failure, this means the sepsis continues to develop into severe sepsis. Simultaneously or stepwise multiple organs stop functioning and affect cardio-circulatory system which leads to sudden drop in blood pressure. The act of this sepsis con-tinuum or transition is known as septic shock. (Woodrow 2012, 318; Tazbir 2012, 206.)

SIRS + PRESENCE OF A KNOWN OR SUSPECTED INFECTION $\Longrightarrow$ SEPSIS

SEPTIC SHOCK $\Longleftarrow$ SEVERE SEPSIS
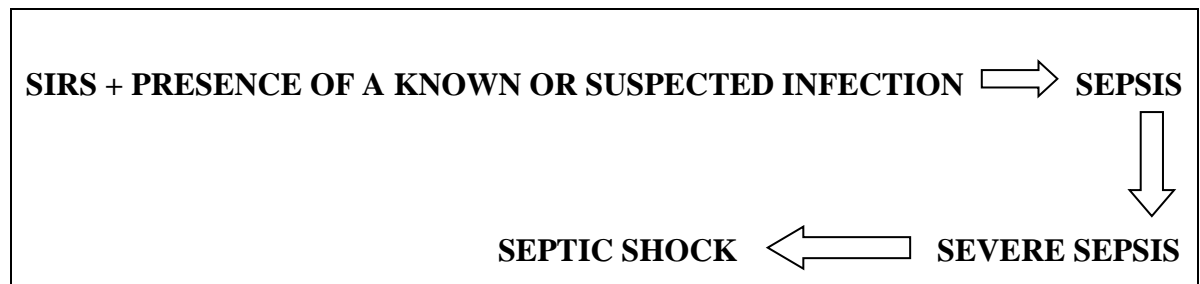
GRAPH 1. Sepsis Continuum (adapted from Tazbir 2012.)

The most common bacteria that cause sepsis are Streptococcus pneumonia, Escherichia coli, Streptococcus pyogenes (beta haemolytic group A) and Staphylococcus aureus in-cluding methicillin-resistant Staphylococcus aureus (MRSA). Furthermore, the less com-mon microbes, which cause sepsis are Klebsiella and other coliforms/extended spectrum beta-lactamase (ESBL) producing organisms, Beta-haemolytic streptococci groups C and G, Anaerobes (Bacteroides fragilis, Clostridium) and Candida albicans (fungal microbes). However, the major conditions that cause sepsis are pneumonia, empyema, intra-abdominal infection, urinary tract infection, wound infection, soft tissue, bone and joint infection, endocarditis, meningitis, bloodstream catheter infection and implantable device infection. (Daniels & Nutbeam 2009, 8-29; Brown, Allen, Yeung & Nguyen 2015, 74.)

2.1.1 Identification of Sepsis

The word 'identification' plays a significant role for ED nurses to recognizing sepsis in a patient. Simply, the term identification means the process of identifying who someone is or what something is (Merriam Webster 2015). Similarly, sepsis identification can be per-formed through diagnostic criteria process. Diagnostic criteria for sepsis include docu-

mented infection or suspected infection with different parameters/variables. Different variables mean the general variables, inflammatory variables, hemodynamic variable, organ dysfunction variables and tissue perfusion variables. (Dellinger, Levy, Rhodes, Annane, Gerlach, Opal, Sevransky, Sprung, Douglas, Jaechke, Osborn, Nunnally, Townsend, Reinhart, Kleinpell, Angus, Deutschman, Machado, Rubenfeld, Webb, Beale, Vincent & Moreno 2012, 169; Daniels & Nutbeam 2009, 7.)

Alternatively, sepsis can be recognized via track and trigger scoring systems such as the Early Warning Score (EWS) or Modified Early Warning Score (MEWS), Patient at Risk Scores (PARS) and Medical Emergency Team calling criteria. All these system are based on the patient's physiological derangement from the normal range. Each system varies, but the common way to collect the track and trigger scores for patient depends on the severity of their abnormality. The scores for each variable are added together, which increases a trigger point. So, according to the trigger point, it requires medical attention to be taken immediately by calling emergency medical team or any another member of the same team. Both Tables 1 and 2 (APPENDIX 1) showed how to collect MEWS score from a set of variables. (Daniels & Nutbeam 2009, 11.)

Table 1 illustrated seven variables such as respiratory rate, SpO_2% (Saturation pulse Oximeter in percentage), heart rate, systolic BP (blood pressure), urine output value, central nervous system (CNS) value and temperature to calculate the score for track and trigger point. The score value 0 represents the normal range of the variables. Below zero, the scores 1, 2 and 3 represents less value than the normal range and whereas above the value of zero, the scores 1, 2 and 3 represents more value than the normal range. Table 2 was an example of calculating variables for track and scoring according to the table 1. It has clarified how to collect MEWS system in the correct manner. Here, an aggregate track and trigger score is 4, which means the patient is mandated for emergency medical attention within half an hour. (Daniels & Nutbeam 2009, 11.)

In UK, an aggregate scoring system is recommended by the National Institute for Health and Clinical Excellence that is also supported by the National Outreach Forum (NOrF). For research study, the MEWS system has been approved as a predictor of outcome in emergency admission. The MEWS system is the first stimulus to follow further a sepsis/severe screening tool. Therefore, it has been used as a protocol in many acute hospital settings in

the UK. A sepsis screening tool is implemented whenever the track and trigger scoring system requires a referral to the emergency room. (Daniels & Nutbeam 2009, 11.)

2.1.2 Assessment of Sepsis in an Emergency Department

This topic is one of the essential parts for the nurses, who work in an emergency department because depending on their documentation and report, patient treatments are decided by doctors. Assessment is one of the important processes of nursing care. To know assessment of sepsis, first the author would like to explain about the term "Assess" which means an act of judging a person or situation or event in certain place based on the facts and evidence. From a nursing point of view, the word assessing comes under nursing process, which refers to deliberate, systematic data collection, organization, validation and correct documentation of information or data of the patient concerned. (Erb's & Kozier 2014, 195.)

In addition, patient assessment requires four different types of assessments. First, the initial assessment is the assessment that includes patient's history and physical examination within 24 hours after admission in the hospital. Second, problem-focused assessment is a continuous process, which is integrated with nursing care. Thirdly, emergency assessment is performed during physiological or psychological crisis of the patient. Lastly, time-lapsed reassessment is performed several months after initial assessment because it will compare the patient's recent status to previously obtained data. (Erb's & Kozier 2014, 194-197.)

In the assessment of sepsis, emergency assessment is undertaken by the emergency unit nurses due to patient's critical condition and things are to be assessed promptly to save the patient's life but in systematic manner. The assessment methods include different activities such as collecting data (along with the subjective and objective process and primary and secondary source), interviewing and examining patient, organization of data, validation data, and documentation data. All the collected and documented data plays a vital role in diagnosing and in nursing intervention. Hence, documenting data means and indicates recording the patient's factual data in right order but not in an assumptive way. For example factual data from subjective process, in the patient's own words must be written by using

quotation marks which will give right meaning to whoever else read the client's records. (Erb's & Kozier 2014, 196-204.)

A standardized clinical assessment tool in the emergency department is sensible to adopt for the benefit of any deteriorating or critically ill patient including those with sepsis and severe sepsis. The sepsis assessment is performed by using the ABCDE (Airway, Breathing, Circulation, Disability and Exposure) system. Airway assessment is implemented when patient's consciousness level is reduced. If the patient is awake and communicating, there are less chances of an airway problem. Hypoperfusion in septic shock triggers the loss of airway. Thus, the patients are detected with airway problem and are immediately administered oxygen. In addition, high flow of oxygen administration will be beneficial for a patient with septic shock or severe sepsis. (Daniels & Nutbeam 2009, 12.)

Similarly, breathing assessment is the most important process to identify respiratory rate via inspection, auscultation, palpitation and percussion. During this procedure, nurse may detect any asymmetry chest movement or expiratory wheezes or crepitations sounds or silent chest, which indicates that the patient requires emergency attention because it is impending towards a respiratory arrest. For instance, if patient with SIRS or severe sepsis or severe heart/lung disease has raised respiratory rate and developed lactic acidosis, then it literally means patient is in hypoxaemia. Thus, immediately patient is administered with oxygen therapy and bronchodilators. (Daniels & Nutbeam 2009, 12.)

Moreover, circulation assessment means giving attention to the clinical signs such as heart rhythm and adequacy of blood flow and it is done through measuring blood pressure. Skin colour must be assessed, particularly in peripheral areas. Pallor skin colour indicates patient is in the hypoperfusion state with low cardiac output. Mottled skin detected in patient is impending circulatory collapse. If the patient experienced such signs, heart sounds should be auscultated or if the patient is experiencing such signs for the first time, it is indicating a subacute bacterial endocarditis as the source of sepsis. Therefore, it is obligatory for an urgent echocardiogram. (Daniels & Nutbeam 2009, 12.)

Disability in sepsis means agitation, confusion and depressed consciousness levels due to reduced cerebral perfusion. However, it can be restored through fluid resuscitation. Moreover, such disability can be resulted via hypoglycaemia. Thus, it is important to measure

the blood sugar level. If the patient is suspected of meningitis with clinical signs like photophobia, neck stiffness and a positive Kernig's sign, senior medical attention should promptly be sought. The early administration of antibiotics play a significant role and simultaneously immediate arrangement of cerebral imaging and lumber puncture investigation prevents patient's outcome from deterioration. The patient's level of consciousness can be assessed by communicating with using the AVPU (Alert, Responds to Voice, Responds to Pain, and Unresponsive) Scale. In addition, if the patients have scored P or U that means they have to undergo with a Glasgow Coma Score assessment. (Daniels & Nutbeam 2009, 13.)

The patient should be inspected thoroughly from head to toe looking for any source of sepsis. Through palpitation and auscultation, nurse should differentiate whether the abdomen is tensed, distended or absent of bowel sounds. If such signs are assessed, nurse should immediately inform to the senior medical practitioner or nurse. After abdomen assessment, examinations are continued to the limbs and joints for swelling and erythema that are impending to septic arthritis or osteomyelitis. Healthcare provider should be observing any indwelling devices in the patient body and evaluated insertion site for any signs of infection. If the site is found inflamed, the indwelling device should be removed as soon as possible under doctors order. During the assessment procedure, patient dignity must be prioritized first and due to patient exposures along with examination can cause a rapid loss in temperature. Therefore, vital signs are measured frequently and monitor the different measurement values as the circulation is restored quickly during fluid resuscitation. (Daniels & Nutbeam 2009, 13.)

2.2 Nurses Working in an Emergency Department

The term emergency means an unexpected and usually related to the dangerous situation, which calls immediate medical action such as major road accident, bomb incident or any severe deterioration in patient's medical condition. Simply, it is defined as a sudden crisis that requires urgent intervention. Whereas, the emergency department is a place where hospital especially equipped and staffed are employed for emergency health care. This emergency department is popularly known as an emergency room or ER. This ER is re-

sponsible for the provision of both medical as well as surgical care to the patients arrived at this ward in the need of immediate medical attention. (Merraim Webster 2015.)

The most common emergency cases that come in the emergency room are sepsis/septicemia, respiratory infections, abdominal infection, chill fever with unconsciousness, severe accident cases such as severe burn cases or road accidents, children with fever, convulsion and ENT (ears, nose and throat) infection. Furthermore, other major common emergency cases those arrive in ED are abscess, skin and wound infection, febrile neutropenia, chest pain, abdominal pain, back pain related to previous injuries or recent trauma and patient with shortness of breath. (Fry, Horvat, Roche, Fong & Plowes 2012, 129-130.)

Moreover, patients who have arrived in ER with such signs and symptoms should be sought for immediate medical attention. In this process, emergency nurses are the first health personnel who interact with the patients in the ER and they are responsible for the initial assessment and management of any disease. Therefore, emergency nurses play a crucial role in identifying diseases according to the hospital protocols and helps in patient outcomes and their satisfaction. (Fry et al. 2012, 128.)

Nurses working in an ER should be trained in how to maintain an interpersonal relationship with patient while communicating during taking medical histories. Hence, a good communication is the core aspect to achieve correct information from the patient. Otherwise, it may affect patient history taking and communication, as well as it can lead to poorer patient outcomes and satisfaction. Therefore, emergency nurses should be well specialized to cope in every situation arising in the emergency department. This means ER nurses should have updated their skills and knowledge by participating in the job training to be competent enough in their nursing jobs. Thus, emergency nurses can provide prompt care to the patient with deteriorating or critically ill conditions. Moreover, they are the backbone of the emergency unit as all the treatments and diagnoses are depending on their documentation and reports. (Burley 2011, 33.)

3 PURPOSE AND RESEARCH QUESTIONS

The purpose of this study was to analyze how nurse identifies and assesses patient's sepsis situation in an emergency department. The study was aimed to raise the awareness among ED nurses, nursing students and health professionals about early identifying and assessing of sepsis. The research goal was to gain knowledge on early recognition of sepsis by the nurses that they can provide evidence-based care with rapid treatment of sepsis reducing poor outcomes. The research questions of this study were as below:

1. How nurses identify patients sepsis in an emergency department?

2. How nurses conduct the assessment procedure of patients with sepsis in an emergency department?

4 METHODOLOGY

Data has been searched from infectious disease department of Kokkola Hospital (Kiuru). However, the information was not enough for this study and also Finnish language was one of the main barriers for the international students to perform quantitative research. Thus, a good approach for this research was a literature review in which author has to study the previous literature in a systematical manner. In addition, the author had to differentiate between contradictions and gaps in existing knowledge of literature and seek to create a new perspective on the topic with distinct contribution. The stages of the methodology in the literature review consist of research question definitions, design of the plan, searching process for literature, applying inclusion and exclusion criteria, applying quality assessment and both meta-synthesis and analysis were accounted. (Jesson, Lacey & Matheson 2012, 10-12.) The definition of research questions were explained in the foundation of the study and other stages were described below.

4.1 Literature review

The researcher has conducted a literature review method in this research. A literature review means reviewing of literature or journals or articles with full awareness and interpretation of what has already been researched and eventually discussed about the contradictions and gaps of existing knowledge. Actually, the term literature review is defined as assembling previous literature information to create new dimension or fresh perspective that makes a distinct contribution to the new project. To perform literature review, the research questions play an important role. After the research questions were fixed by researcher, the core aspect was to gather evidence based research journals to answer the questions. The literature review was the way of summarizing and synthesizing research studies to analyze previous studies on specific phenomena. Therefore, literature review was a collection of secondary analyses of explicit knowledge in which abstract concepts of explicit and tacit knowledge are explored to form a new set of approach. (Jesson et al. 2012, 9-10; Dahlberg & McCaig 2010, 76-77.)

There are two types of literature review. They are traditional literature review and systematic literature review. The traditional literature reviews are generally reviewed critically, but not in pure descriptive way. The approaches usually applied in the traditional review are critical approach, conceptual approach (synthesis of conceptual knowledge), state-of-the-art approach (up to date on the most recent study), expert approach (an acknowledged expert), and scoping approach (sets view for future research). Despite of these approaches, the traditional literature review targets to be reflective but, it may produce a one-sided or even a biased review. On the other hand, systematic literature reviews are an essential tool including traditional reviews as it helps to recognize gaps in the knowledge and clarify more technically with rationale and standardized process by demonstrating its objective and transparent study to the reader. (Jesson et al. 2012, 14-15.) The definition of systematic literature review according to Sweet and Moynihan in the Jesson et al. (2012, 104) as below:

Systematic reviews provide a systematic, transparent means for gathering, synthesizing and appraising the findings of studies on a particular topic or question. The aim is to minimize the bias associated with single studies and non-systematic reviews.

4.2 Inclusion and Exclusion Criteria

The essential step of literature review was to set the parameters for gathering the relevant literature. The parameters mean planning a data search how it should be conducted so that the researcher can determine right materials and sources for the study. Therefore, the inclusion and exclusion criteria were carried out which must be explicit to answer the research questions. Moreover, it was a limitation and reminder for researcher while searching the articles before, after and between the research processes. In addition, strict documentation of the data search process was essential to ensure that the study would show the transparency and logic of every researcher decision for the research. (Dahlberg & McCaig 2010, 78; Jesson et al. 2012, 115-116.) As a result, the researcher has sketched a clear search strategy for inclusion and exclusion criteria presented in Table 3 and further documented the inclusion criteria articles for findings as shown in Table 5 (APPENDIX 2).

TABLE 3. Inclusion and exclusion criteria used in this research

Inclusion	Exclusion
Articles available in full text with abstract and peer review within the keywords.	Articles not available in full text with abstract and peer review within the keywords.
Free access from school library databases.	Charged access
Articles published from 2011 to present date.	Articles published before 2011.
Studies available in English language.	Studies available in other languages.
Evidence-based research articles related to nursing	Articles not related to nursing and not based scientifically.
Studies considered both qualitative and quantitative approaches.	Studies with other than qualitative and quantitative approaches.

Table 3 has represented the inclusion and exclusion criteria of the data search. The included materials for this research were those which had full text with abstract and peer review within the keywords, and were available and allowed free access from school library databases. The literature search was limited to the journals with publication dates between the years 2011 to the present date. The limitation for included articles written and published also required English language. Moreover, the author has included only evidence-based articles related to nursing and has considered both qualitative and quantitative approaches for this literature review. On the other hand, the excluded articles were not in full text with abstract and peer review within the keywords and were charged access. The data were excluded if the published dates were before 2011 and also studies were available in other language than English language. Furthermore, the exclusion criteria include articles not related with nursing as well as not considered articles that had other than qualitative and quantitative approaches.

4.3 Data Collection and Selection

The data was collected from Centria University of Applied Sciences library computerized databases such as EBSCO, Sage Premier, Ovid, Science Direct and Google Scholar, which contain more recent information about the topic. First, the inclusion and exclusion criteria were formulated in the data collection process. In each and every step, researcher has followed those criteria as a blueprint for searching the evidence-based journals. The data was searched by keywords using Boolean's, which has been shown clearly below in the Table 4. The original materials collected for this study were 122 journals from the databases according to reading the titles. Then, the researcher has reviewed the materials by identifying the abstracts and screened with 84 journals out of the 122. Moreover, researcher has continued filtering 84 journals by reading their results and got 16 journals for data analysis. Through the process of inclusive and exclusive criteria the study materials were gathered and optimal data were collected. Furthermore, articles were searched from famous nursing journals such as Intensive and Critical Care Nursing, Journal of Emergency Nursing, International Emergency Nursing, Journal of Perianesthesia Nursing, International Journals of Nursing Studies and Australasian Emergency Nursing Journal.

TABLE 4. Articles searched result from the databases using Boolean's (Table continues in the following page)

Keywords	EBSCO	Sage Premier	Ovid	Science Direct	Google Scholar
Sepsis	1817	153	896	261	14800
Sepsis OR blood poisoning	1958	153	898	263	130
Sepsis OR blood poisoning AND identifying	1815	0	171	1400	18
Sepsis OR blood poisoning AND identifying OR recognizing	2323	0	1213	1519	22
Sepsis OR blood poisoning AND identifying OR recognizing AND assessing	1819	0	250	950	254
Sepsis OR blood poisoning AND iden-	7729	0	2376	1185	494

tifying OR recognizing AND assessing OR evaluating					
Sepsis OR blood poisoning AND iden-tifying OR recognizing AND assessing OR evaluating AND nurse	2021	0	1435	722	116
Sepsis OR blood poisoning AND iden-tifying OR recognizing AND assessing OR evaluating AND nurse OR nursing	39509	0	19184	722	389
Sepsis OR blood poisoning AND iden-tifying OR recognizing AND assessing OR evaluating AND nurse OR nursing AND emergency department	2536	0	1415	166	388
Sepsis OR blood poisoning AND iden-tifying OR recognizing AND assessing OR evaluating AND nurse OR nursing AND emergency department OR emer-gency room	2447	0	1695	181	32

4.4 Data Analysis

The main purpose of conducting the data analysis was to reduce the number of collected materials in organized way and to provide a meaningful evidence-based research (Burns & Grove 2011, 52-53). The data analysis simply, means a rigorous detailed examination of the included data in the study. The type of data analysis was driven via research objectives, questions or hypotheses. Thus, the data analysis can be divided into quantitative and quali-tative data analysis approaches. (Burns & Grove 2011, 94.) The collections of data were analyzed by the use of meta-analysis and meta-synthesis approaches. Meta-analysis was a cumulative statistical form of systematic literature review. It was determined by the com-bination of quantitative findings of independent studies on the same topic that have been already known and published. Thus, the integration of results from different quantitative findings enhanced good understanding of new knowledge. (Jesson et al. 2012, 128-130.)

Nevertheless, meta-synthesis data analysis was a non-statistical cumulative form of systematic literature review that has been obtained via multiple bodies of qualitative research findings. It integrates, interprets and analyzes qualitative results on the basis of either inductive or deductive approaches. JBI (Joanna Briggs Institute) model of meta-synthesis has applied meta-aggregative approach to synthesis of qualitative evidence studies. Additionally, meta-aggregative approach was a delicate conventional subject of the qualitative study while being predicated on the process of literature review. Therefore, to perform meta-synthesis data analysis, the JBI has developed QARI (Qualitative Assessment and Review Instrument) computer software to promote the meta-aggregation of qualitative research. However, the QARI computer software was unable to be accessed, thus the author has assessed included data by reading the QARI thoroughly and tally them systematically. (Joanna Briggs Institute 2014, 19.)

Data were evaluated by the author through constant comparison techniques that involves comparing coded with other data and undergoes the three levels of data analysis. The first level of coding means line by line reading of the data, whereas, second level of coding was to compare new data with the first level codes. The third coding includes grounded theory strategies of noting and diagramming of the parameters to improve the credibility of the theory. Hence, the data analysis was a challenging task as interesting data is found but it did not match with the inclusion criteria such as with published date or with subject that did not have any relation at all. At that time, researcher found so difficult to reject such data. (Burns & Grove 2011, 449.) In this research, the data was gathered through thorough reading of included data and divided results into two parts (meta-analysis and meta-synthesis).

4.5 Data Assessment

The quality of the collected articles was accepted only via their discipline of evidence. The medical science has widely approved the double-blinded controlled trials and the crossover randomized trials as gold standard quantitative methodologies, whereas qualitative interview and descriptive study's methodology were ranked as the ones with least credibil-

ity. (Jesson et al. 2012, 116.) The quality assessment of data in this research has been done through the JBI tools of QARI (JBI Qualitative Assessment and Review Instrument) and MAStARI (JBI Meta-Analysis of Statistics Assessment and Review Instrument) for meta-synthesis and meta-analysis respectively. (Joanna Briggs Institute 2014, 9.)

However, the collected data were 122 articles in total, which were assessed according to the required keywords and were performed in systematic ways. The author has concentrated on how nurses can early identify septic patient and how nurses conduct the assessment procedure of the patient with sepsis in an ED and has gathered data associated with it only. 106 articles had been excluded due to various reasons. The stepwise reasons for exclusion of the articles were that the data were not related to nursing (67 excluded), the articles did not access full-text version (11 excluded), the articles did not mention about identification of sepsis (9 excluded), some articles were considered to be purchased (11 excluded) and lastly the articles had only abstract part with little portion of the text (8 excluded).

4.6 Ethical Consideration

Ethical consideration in research means an essential moral that is needed to generate empirical knowledge for the evidence-based practice (Burns & Grove 2011, 103). The author has strictly maintained the code of ethics throughout the thesis as it was the vital part of this study. The validity and reliability of this research has been maintained according to the primary source of the evidence based articles. Moreover, the reliability of this research project was most recent and up to date data. The achieved articles for findings were limiting the date of publication to at least the last five years. The school's library database was conducted while searching for the journals. (Jesson et al. 2012).

5 FINDINGS

The literature review included 16 articles (9 articles related to the qualitative method and 7 articles related to the quantitative method) , which discussed in detailed on sepsis screening tool as the main theme along with sepsis assessment procedure to identify and assess patient's sepsis in the ED. The findings of this study were generated through the accumulation of meta-synthesis and meta-analysis process, which answered the research questions. During analyzing the data, the author has differentiated the included articles into qualitative and quantitative review methods. As a result, the author has extracted research answers by thorough reading of the included data.

5.1 Sepsis Identification and Assessment Tool According to the Meta-synthesis

For meta-synthesis, the author has chosen 9 articles. Early work by Vanzant & Schmelzer (2011, 51) determined four strategies to identify sepsis, which includes SIRS criteria, ten vital indicators of body functions, serum lactate levels and cognitive changes. In addition, the reviewed study has discussed sepsis screening using SIRS criteria. The SIRS criteria consists of heart rate, respiratory rate, temperature and WBC count (Vanzant & Schmelzer 2011, 51). Another study on the topic by Robson & Daniel (2013, 78) have expanded EWS systems by adding SIRS criteria to recognize sepsis. Moreover, if the patients score ≥ 4 based on EWS plus two or more SIRS criteria (positive sepsis screen), the bedside nurses immediately contacted a nurse practitioner or physician and begin screening for the confirmed or potential source of infection. (Vanzant & Schmelzer 2011, 51; Robson & Daniel 2013, 78).

On the other hand, the reviewed article by Hancock (2014, 101) has replaced EWS by National Early Warning Score (NEWS), which has been evaluated and titled as a 'superior' than EWS and also predicting death within 24 hours. The NEWS system was developed to use in the acute settings like ED, the trigger points of 3, 6 and 9 corresponded to low, medium and high risk with the accompanying mnemonic of 3 = THREAT, 6 = SIX and 9 = NOW (Hancock 2014, 102).

Besides, Robson & Daniel (2013, 78) have added two more important signs and symptoms in SIRS criteria, namely glucose level test and acutely altered mental state respectively to detect sepsis in organized manner and it was revised in 2001 by International consensus conference of sepsis. The most obvious explanation of acutely altered mental state means cognitive changes in the patients with an infection or sepsis. Moreover, cognitive changes consist of delirium, which was noticeably common sign of UTI, especially often found in the elderly adults. Additionally, delirium is a disturbance of consciousness characterized by four main features. They are acute onset and fluctuating course, inattention, disorganized thinking, and altered level of consciousness. Therefore, to evaluate the delirium in deteriorating patients; the Confusion Assessment Method (CAM) tool was implemented. (Robson & Daniel 2013, 78; Vanzant & Schmelzer 2011, 52.)

Furthermore, the CAM is a standardized evidence-based tool consisting of questions that identify and analyze delirium accurately and quickly in clinical setting. Thus, the CAM tool has the greatest ability to distinguish delirium from other cognitive impairment like dementia. Consequently, the patients are diagnosed as delirium if they scored 1 and 2 and either 3 or 4 from CAM examination. In the ED setting, the short version of the CAM are used as it is easy to be conducted and takes only 5 minutes if used by trained nurses to complete the procedure. Finally, any patients who arrive in the ED at triage undergo through CAM, which provides a baseline assessment for identifying cognitive status. (Vanzant & Schmelzer 2011, 52.)

Moreover, as Vanzant & Schmelzer (2011, 52) illustrated briefly on delirium features because it is one of the most important symptoms unnoticed in the sepsis patients and are worthwhile for assessment process. The acute onset, first feature of delirium can be usually obtained from a family member or nurse, whereas the fluctuating course of delirium is examined by continued reassessments of cognitive status. Inattention is the second feature of delirium, assessed by analyzing the patients' conversation and their attention to the conversation. Thus, the standard questions to evaluate patients inattention by asking them to count from 20 backward or spell the word 'world' backward. The third feature is disorganized thinking, which can be identified via patient's disorganized flow of ideas and in addition patients do not make sense when talking. Lastly, patient's altered level of con-

sciousness can be detected by hyper alert, lethargic, drowsy, fatigue, stupor or coma. (Vanzant & Schmelzer 2011, 52.)

Furthermore, Vanzant & Schmelzer (2011, 51) added that recognition of early sepsis was so difficult because of its diverse symptoms. Therefore, to solve such problem the same study as well as reviewed article by Bushnell Demaray, & Jaco (2014, 9) assessed most important physiological symptoms. They were fluctuation in temperature, tachycardia, new or variation in pain, systolic BP and mean arterial BP decreased, altered WBC, increased CRP, change in consciousness level, capillary refill > 3 seconds, urine output < 30ml/h, $ScVO_2$ changes (measured through blood gas analysis) and $SaO_2 < 90\%$ (oxygen saturation via arteries). In addition, the study has indicated that changes in any 2 or more of them were noticed as highly specific for sepsis. (Vanzant & Schmelzer 2011, 52.)

Similarly, the reviewed study by Bohm, Kurland, Bartholdson & Castren (2015, 296) have determined the most common symptoms in a septic patient that the callers had mentioned were breathing difficulties and difficulties in establishing contact with patients who were at critically ill state and had lowered level of consciousness. Thus, sepsis can be defined in terms of physical symptoms, changes of behavior and communication abilities of the patient according to the reviewed article. Moreover, these three elements play dominant role in recognizing sepsis and that could be also incorporated into the decision tool used by the emergency medical dispatcher to enhance the sepsis identification. (Bohm et al. 2015, 296-297.)

One reviewed article has explained about how to identify and assess source of infection after the patients were positively screened to sepsis in detail. The nurses working in the acute setting play a crucial and direct role in obtaining blood samples for culture and in administrating antibiotic therapy. However, in order to identify the right causative organisms, lab technician are asked to collect blood samples for culture both aerobic and anaerobic as soon as possible before antibiotic therapy initiation. Simultaneously, assessment processes were performed along with sepsis diagnostic procedure, if the patients were suspected of any other source of infection such as UTI, lungs infection and chronic wounds (pressure sore), lab technician were called once again for the tests like urine examination, respiratory secretions, wound biopsy or secretions and other body fluids to identify main

source of infection and ensure that the patient receive prompt and right antibiotic therapy on time. (Kleinpell, Aitken & Schorr 2013, 214.)

Whereas, the other publication on the topic by Bushnell et al. (2014, 11) distinguished examination of source of infection by withdrawing serum lactate for positive screens and blood cultures were obtained prior to initial antibiotic administration. In addition, antibiotic therapy was administered within 1 hour of order initiation and fluids intervention to all patients on the Red pathway. This actually suggesting that Red Pathway includes identification of patients who have had positive blood cultures and abnormal lactate test results. Consequently, serum lactate investigation was used as marker for positive screen as it was associated with sepsis mortality. Similarly, Dumont & Harding (2013, 625) have emphasized that in the ED, there should be developed and implemented an evidence-based new standardized assessment tool which has mentioned ordering the blood cultures automatically including a serum lactate test for any ED patients. This indicates that the ED nurses can soon be evaluating patient sepsis particularly with serum lactate diagnosis. (Dumont & Harding 2013, 626.)

Additionally, the rationale of serum lactate level was a reflection of the cellular hypoxia, severity of shock and hypoperfusion. Therefore, the measurement of serum level plays significant role in detecting early sepsis in ED patients who were at higher risk. (Vanzant & Schmelzer 2011, 52; Dumont & Harding 2013, 626.) Furthermore, as Vanzant & Schmelzer (2011, 51) added that if the patient had not been detected an infection, nurses should reassess the patient, review all the data and initiate the treatment. Nevertheless, the same study has highlighted that serial serum lactate tests would be more beneficial than initial lactate level, if the patient was only suspected of sepsis but not verified yet.

Synchronously, the ED nurses would evaluate source of infection via performing general assessment of the patient during daily routine procedures. For example, when bathing a patient one may detect the areas of redness, tenderness and inflammation, which may identify the presence of abscess and the site of catheter drainage or vascular access catheter may be suspicion of catheter-associated bloodstream infection. Thus, the ED nurses should discontinue it with consulting ED physicians. In addition, astute clinical assessment, documentation and reporting of such signs and symptoms help nurses to recognize source of infection. Furthermore, ED nurses should always make-up their minds with infection

prevention measures during performing sepsis screening diagnosis or any assessment procedure such as hand hygiene, catheter care, barrier precautions, elevation of bed-head, mandatory of oral care with subglottic suctioning and other measures should be maintained to prevent further complications such as severe sepsis or septic shock. (Kleinpell et. al. 2013, 215)

Besides, ED nurses have a great influence on maximizing the sepsis identification, the source of infection as well as ensuring that the patients receive prompt antibiotic treatment within 1 hour of sepsis recognition. (Dumont & Harding 2013, 626; Makic 2013, 241; Turi & Von 2013, 15; Bushnell et al. 2014, 11; Hancock 2014, 101). However, the study by Dumont & Harding 2013) explained that if the physicians were busy or unable to see the patient immediately, the ED nurses were authorized to administer broad spectrum antibiotics for an infection of unknown source as soon as possible within 3 hours of the patient's triage assessment. Thus, to identify source of infection in ED patients, nurses should assess other sepsis diagnostic criteria in systematic way such as portable chest X-ray or CT (computerized tomography) scan. However, in diagnostic process some examinations need to be prescribed by ED physicians or medical residents. Without their orders, patients were unable to receive initial resuscitation and it affects the outcomes. Hence, delay in sepsis diagnosis means obviously delay in patients life-saving care. (Turi & Von 2013, 16; Kleinpell et al. 2013, 216)

According to Kleinpell et al. (2013, 214), the main obstacle to initiate sepsis care bundle were lack of early recognition of sepsis. In addition, they have mentioned that the sepsis screening tool for early recognition of sepsis can be more activated by performance improvement among different personnel of the healthcare setting. The performance improvement means an accumulation of different areas of aspects, which need to be accounted to enhance the identification of sepsis more rapidly such as education (nurses, physicians and other healthcare professionals), protocol development with good implementation program, data collection, measurement of indicators and relay ongoing feedback or suggestions to clinicians, administrators, nurse educator, quality improvement staff and other health related co-workers. (Bushnell, et al. 2014, 11; Dumont & Harding 2013, 626; Kleinpell et al. 2013, 214.)

Moreover, the education in prior sepsis screening was noteworthy and involves formal or informal classes, in-service sessions, trainings and even circulation of information among and to multi professional teams. (Turi & Von 2013, 16; Kleinpell et al. 2013, 214; Dumont & Harding 2013, 626). A different approach by Dumont & Harding (2013, 626) have created an electronic computer-based learning (CBL) modules whilst Bushnell et al. (2014, 11) have also invented an electronic database with only sepsis order sets to enhance identification of sepsis. In addition, CBL includes all important topics related to sepsis such as definition and pathophysiology, signs and symptoms, risk factors, strategies of mortality reduction, screening tool and early interventions and fluid administration procedure, which were the main success keys for sepsis early identification tools. Thus, the sepsis education before implementation of sepsis screening or sepsis care bundle were beneficial as well as challenging due to some of its barriers. For instance, nurses' or physicians' resistance to change, difficulty in implementing of protocols and lack of knowledge regarding sepsis because of novice or less experienced nurses. (Bushnell et al. 2014, 11; Dumont & Harding 2013, 626; Kleinpell et al. 2013, 214.) Furthermore, the reviewed study by Turi & Von (2013, 16) have added that collaboration and preplanning among interdisciplinary team can be more effective in achieving the early sepsis identification.

In contrast, the reviewed articles have emphasized that the best adherence to the current guidelines designed with the use of ED sepsis order set for the management of initial sepsis started on the arrival to the ED at the zero time period of triage and it continues with the inpatient order set. Sepsis order set or sepsis 6 bundles consists of antibiotic therapy, IV fluid therapy, oxygen delivery, taking blood samples for cultures and lactate measurement and monitoring of urine output chart. Although, the blood culture, IV fluid administration and serum lactate investigations were common sepsis order sets and performed during the examination of source of infection. (Dumont & Harding 2013, 625-626.) Conversely, another study on the topic by Hancock (2014, 103) mentioned about only 4 sepsis care bundles, which includes the admission, recognition, response and sepsis 6 bundles. In addition, the article has discussed that first two bundles were driven by nurses and other two (sepsis response and sepsis 6 bundles) were on the hand of physicians. Thus, the use of such care bundles had showed tremendous effect upon sepsis process reliability and in its outcome. (Hancock 2014, 103.)

The latest research (Hancock 2014, 103) focused on Situational, Background, Assessment and Recommendation (SBAR) tool with combination of communication tool among the nurses and physicians made helpful for early identification of sepsis. The same study has formed a RRAILS bundles, which has implemented SBAR and communication tool. Hence, the important aspect for promotion of RRAILS care bundles were changing behavior and not generating numbers. For examples, 1) keen observation from the time of admission of deteriorating ED patients, 2) nursing staff's alertness starts from the duty shift and during each shift and even at nights and weekends. Therefore, to change the culture in the team, communication and situational awareness tools had great impact on patients' outcome. Both tools can be possible only by making patient information highly visible among team by standardizing processes and documentation of patient condition. (Hancock 2014, 103.)

Furthermore, for standardizing documentation, teams were encouraged to implement Patient Status at a Glance (PSAG) tools on white board in which NEWS points and frequency of observations were recorded. However, the reviewed study by Dumont & Harding (2013, 627) have narrated the patient with suspected sepsis was recorded in nurse-driven electronic database by marking red 'S' that appears next to the patient's name. This means the teams were more aware by alerting themselves. Besides that, the Glance tool on white board represents the patients current situation and brief emergency safety measures concentrating upon the patients who were at most risk. Therefore, adaptation of PSAG boards with brief description of patient has made the evaluation far easier and more useful, in particular in the admission and recognition bundles. (Hancock 2014, 104.)

Finally, the documentation of sepsis screening was standardized and demonstrated in the SBAR format. Moreover, the expanded version of SBAR includes Standard Operating Procedures (SOPs) such as sepsis response bag that initiate escalation and delivery of the sepsis 6. Besides, if the patient scores 3 on NEWS plus positive screened to sepsis, patients were ordered additional diagnostic tests and rapid treatment and aggressive actions were considered. This means that nurses have approached physician using SBAR and communication through the PSAG tool, hence patient received initial resuscitation and aggressive action immediately. (Hancock 2014, 103-105.)

In addition, Communication tools with combination of SBAR among teams have achieved > 95% compliance with admission and recognition bundles. Hence, it has influenced in the safety culture and provides assurance on the reliable implementation of NEWS. The reviewed article has observed that the compliance of admission and recognition bundles were generally achieved and controlled by nurses, whereas the response and 'sepsis 6' bundles were at slower pace as both bundles required the input from physician and medical residents. (Hancock 2014, 103-105.)

5.2 Sepsis Identification and Assessment Procedure According to the Meta-analysis

For meta-analysis, the author has reviewed seven studies and answered the research questions. Almost all seven articles have had their results extracted by using SSC guideline, which was based on the severe/sepsis screening tool and sepsis bundles. (Fleming, Forster, Savage, Sudholz, Jacobs & Daley 2011, 99; Kent & Fields 2012, 139; Burney, Underwood, McEvoy, Nelson, Dzierba, Kauari & Chong 2012, 514; Moss 2014, 5; Jeffery, Mutsch & Knapp 2014, 271; Bruce, Maiden, Fedullo, & Kim 2015, 134; Suberviola, Lopez, Ortega, Mazarrasa, Santibanez & Martinez 2016.) Out of 7 studies, 2 studies researched on knowledge and identification of SIRS and sepsis among nurses and physicians and acute and critical care paediatric nurses (Burney et al. 2012; Jeffery et al. 2014).

According to Burney et al. (2012, 515), the data found among the ED physicians and nurses have reported being familiar with SIRS criteria were 72.7% and 85% respectively whilst another study on the topic by Jeffery et al. (2014, 274) determined their data among acute and critical nurses by separating SIRS criteria into heart rate, temperature, WBC count and respiratory rate were 97%, 96%, 91% and 77% respectively. In addition, most nurses have correctly identified heart rate, temperature and WBC count than respiratory rate regarding recognition of SIRS. In contrast, the study by Burney et al. (2012, 515) analyzed 68.5% majority of nurses have expressed that they were very much confident in identifying septic shock in triage period, if the patients were suspected of pneumonia. Whereas, in the reviewed article by Jeffery et al. (2014, 274) mentioned that only 57.9% of participants felts comfortable recognizing SIRS. This means that in both studies, nurses

were not confident enough to identify SIRS criteria (Burney et al. 2012, 515; Jeffery et al. 2014, 274).

Moreover, both same articles have viewed on the knowledge regarding serum lactate level among participants, in which physician hardly ever order and nurses hardly ever received the orders of it for the diagnosis of sepsis and have resulted almost same percentages of statistical data on physicians ordering the serum lactate examination. Therefore, 43.2% of physicians have hardly ever ordered a venous lactate culture when ordering blood cultures whilst the nurse participants have also stated that they have hardly ever received orders from physicians for venous lactate test (43.9%) (Burney et al. 2012, 515). However, 43% of acute and critical nursing respondents have chosen to order a serum lactate level. In addition, the majority of acute and critical nursing participants have correctly recognized Complete Blood Count (CBC) with differential, blood gas analysis, oxygen saturation and serum blood glucose level (Jeffery et al. 2014, 273).

Early work by Fleming, Forster, Savage, Sudholz, Jacobs & Daley (2011, 99) assessed suspected sepsis in term neonates only via clinical signs and laboratory markers (CBC and CRP). The most common sign determined in the neonates during evaluation to rule out sepsis process was respiratory distress of 38%. Subsequently, the another clinical signs were temperature instability (9%), cardiorespiratory depression during the time at birth (7%), poor feeding (6%), jaundice (6%), cyanotic episode (4%), decreased muscle tone(4%), red or smelly umbilicus(4%), suspected skin infection (2%) and lethargy (2%). Moreover, the study has investigated neonates CRP (C-reactive Protein) in the diagnosis of early onset of infection (within 48 hours of birth). As a consequence, in the initial assessment phase of sepsis suspicion, the CRP in particular increases very slowly and has sensitivity of only 60%, whereas at 24- 28 hours the sensitivity of CRP elevated by 82% -84%. Thus, the reviewed study decided to perform serial CRP and procalcitonin investigations for better results and determined that they provide correct and faster results than the normal CRP during the acute phase of infection. Finally, the author has mentioned that the timing of evaluation was one of the essential aspect in the diagnosis of clinical sepsis. (Fleming et. al. 2011, 101-102.)

Nevertheless, the latest research (Bruce, Maiden, Fedullo & Kim 2015, 134) analyzed data on adult patients based on pre and post nurse-initiated ED sepsis protocol on time for

initial antibiotic therapy. Additionally, the pre and post protocol comparison were performed between two groups by implementing 2 out of 4 elements of 3 hours SSC bundles. They were serum lactate measurement and obtaining blood cultures prior to antibiotic administration for the suspicion of sepsis. As a result, the statistical data in compliance with serum level measurement had significantly improved by around 15% (83.9% before protocol vs 98.7% after protocol). Moreover, the antibiotic therapy within the 3 hours of ED admission had found only 1.5% of compliance rates difference in the groups (75.8% vs 77.3%). Therefore, the article reviewed that the laboratory investigations were independently ordered by the ED nurses to recognize sepsis early as the compliance that required medical interventions with multidisciplinary response was labeled as suboptimal. (Bruce et al. 2015, 134.) Likewise, another study on the topic by Moss (2014, 12) mentioned the recommendation according to the evidence-based sepsis literature was to administer the first dose of antibiotic within the first hour of presentation of sepsis symptoms regardless of confirmation**.**

Also, the study by Bruce et al. (2015, 134) illustrated that almost one-quarter of sepsis patients did not receive antibiotic therapy in time. Similarly, patients of one-fifth did not receive target IV fluid volume within the 3 hours of ED admission. It was due to delayed medical intervention by ED physician, thus rapid communication was needed to avoid such hindrances. Nevertheless, the findings regarding the median time to initial antibiotic treatment was reduced by 27 minutes after implementation of protocol. (135 minutes vs 108 minutes). (Bruce et al. 2015, 135.) whilst the early study by Moss (2014, 12) discovered more less time frame of the septic patient from triage to treatment (29.2 minutes to 15.5 minutes) and that was decreased significantly by 50% after implementing the sepsis screening tool. This ultimately affects mortality and morbidity rate and significantly saves patients' lives. Hence, the sepsis screening tool was regarded as the golden standard tool for determining the degrees of sepsis. (Moss 2014, 9-12.)

The latest research with a different approach by Suberviola et al. (2016, 69) discovered SeptiFast test for early recognition of sepsis. The reviewed article has compared SeptiFast test and blood cultures to detect and diagnose sepsis in patient. The SeptiFast test means a multi pathogen probe based real-time PCR (Polymerase Chain Reaction) system targeting DNA (Deoxyribonucleic acid) sequences of bacteria and fungi in blood samples. Moreover, it deemed to be a potentially valuable complementary tool in the management of pa-

tients with suspected sepsis. The reviewed study has determined that in the SepsiFast test, the possibility of isolating at least 1 microorganism was 13 times greater than blood culture test at 6 hours. In SSC guideline, there mentioned that blood cultures should be always obtained before antibiotic administration because the risk of showing no growth of micro-organisms was significantly high. However, in SeptiFast test, blood can be investigated also after antibiotic treatment and did not influence in the results at all. (Suberviola et. al. 2016, 70-71.)

Moreover, the surveyed patients in the blood cultures test who had already started antibiotic therapy were resulted with lower sensitivity test and higher in false negative rate. All positive blood cultures have detected single microorganism nevertheless, SeptiFast had detected polymicrobial infection in 9 cases (8 cases with 2 microorganisms and 1 case with 3 microorganisms). The source of infections for these 9 cases was peritonitis (7 cases), urinary tract (1 case) and soft tissue (1 case). In addition, the reviewed article has demonstrated that SeptiFast test determined 25 cases as positive results although, the blood culture results were negative. The SeptiFast test solely assayed and isolated multiresistant pathogens (Acinetobacter baumannii, Aspergillus fumigatus, Candida albicans and Pseudomonas aeruginosa). Furthermore, Escherichia coli and Klebsiella pneumoniae/ oxytoca were highly detected via SeptiFast test within 6 hours. (Suberviola et al. 2016, 72.)

In contrast, the reviewed study by Kent & Fields (2012, 139) developed severe sepsis screening measure/tool based on SSC guidelines to evaluate early recognition of sepsis and reduce mortality rate. The severe sepsis screening measures consists of 4 sections. They are SIRS criteria (Section 1), infection criteria (Section 2), organ dysfunction criteria (Section 3) and SBAR communication (Section 4). (Kent & Fields 2012, 141.) Patients whose condition was at high risk were undergoing through severe sepsis screening measures in the ED. Thus, according to Kent & Fields (2012, 141), they have followed screening tool in organized manner for their research and found that implementing such measure can be decreased in the sepsis morbidity rate.

Furthermore, the data were collected from 200 patients before implementation and 206 patients after implementation of severe sepsis screening tool. The results of patients in the ED at triage prior to its implementations those met SIRS criteria, infection criteria and organ dysfunction criteria were 28%, 21%,and 1% respectively and no statistical data were

found in SBAR communication section because the survey did not progress to SBAR communication section. However, the outcomes from after implementation of severe sepsis screening tool were determined in fewer patients who met SIRS criteria, infection criteria, organ dysfunction criteria and require SBAR communication criteria or not were 15%, 7% and 2% respectively. (Kent & Fields 2012, 142.)

Therefore, 2% of patients who met organ dysfunction criteria got an opportunity to have further investigations using SBAR communication with physicians by the ED nurses. This indicates that the severe sepsis screening tool worked as a bridge between patients and physicians and plays a vital role in early recognition of sepsis. Thus, SBAR communication actively collaborates with ED physicians in the assessment and treatment of sepsis and reduced the sepsis mortality as well. (Kent & Fields 2012, 142.) Similarly, the study by Bruce et al. (2015, 134) also added that communication between nurses and physicians was foremost step to enhance the patient conditions and reduce morbidity and mortality related sepsis.

6 DISCUSSION

The discussion part consists of following subheadings such as methodological considera-
tion and limitations, ethical considerations and its validity, discussion of the findings, im-
plication for nurses and author's learning process.

6.1 Methodological Considerations and Limitations

The main purpose of this study was to analyze identification and assessment procedure of
sepsis in the emergency department patients by nurses. Thus, the author would like to solve
the research questions by choosing the appropriate research methods. In the beginning of
the research, the author has faced different growth and developmental challenges to pro-
ceed with the research methodology. First, the author has collated data from infection dis-
ease department of Kokkola Hospital. However, the information was not enough for this
study and also Finnish language was one of the main barriers for the international students
to perform any other form of study such as quantitative research. Hence, the author had
decided to choose a literature review as an appropriate research method for this study and
performed meta-synthesis and meta-analysis of data to answer the research questions.

To commence, the author has searched for the research keywords for the literature review,
which was a bit hard task to finalize. Nevertheless, the final keywords were formed and the
author has started searching for previous literature journals via accessing school library
databases. During the data searching process, the author has asked for help from school
librarian about how to conduct the data search process correctly. The school librarian has
helped the author immensely to achieve ideas regarding how the data searching process has
to be conducted. After receiving the right track for data searching process, the author start-
ed to gather the literature reviews in organized and systematic manner.

In addition, the author preplanned to initiate the research by developing Gantt chart be-
cause time is an important factor to complete the study. The Gantt chart is timetable
planned for the research study and it is the flexible tool. Therefore, in the initial phase, the
author has chosen the topic and prepared the research plan. In second phase, the author has

implemented the scan and skims the collected articles with thorough readings and note makings. Lastly, the author has synthesized and begun to write the thesis. During writing the research project, the author has recorded and stored data by using paper and electronic versions. Apart from the Gantt chart, the author conducted a few meetings in between the research process with thesis instructor regarding the study. Consequently, the author received evaluation, feedback and suggestions for enhancing the research project. This study has no limitations as the author has found appropriate and enough materials and that were free of charged

6.2 Ethical Considerations and Validity

The author has strictly maintained the code of ethics throughout the thesis writing process as it was the core part of this study. The reliability and validity of the study has been determined by considering careful documentation of primary sources including evidence-based nursing journals. Hence, the transparency of included sources and their extraction was enhanced by adopting and complying the highly approved systematic literature review. This indicates that the data were collated with the inclusion and exclusion criteria of this study and consolidated with required table in the research project. Finally, the findings of this research could be considered as reliable and reproducible.

6.3 Discussion of the Findings

The findings were considered as an answer to the research questions comprehensively. Hence, the results have been discussed in detailed on sepsis screening tool as the main theme along with sepsis assessment procedure to identify and assess patient's sepsis in the ED. In meta-synthesis and meta-analysis findings, the sepsis screening tool and sepsis bundles based on SSC guideline were followed to identify and assess for early recognition of sepsis. The sepsis screening tool consists of NEWS, SIRS criteria and source of infection. However, in sepsis care bundles or sepsis 6 care bundles or sepsis order sets includes antibiotic therapy, oxygen delivery, IV fluids intervention, taking blood samples for cul-

tures and serum lactate measurements, and monitoring urine output for the identification and assessment of sepsis. This bundle was practically used in the ED patients at triage time to diagnose sepsis by ED nurses and physicians. Therefore, these tool and bundle were combined to detect patient situation for sepsis. In addition, to define patients' positive to sepsis screening, ED nurses should be following three conditions. They were NEWS of 3 or more, two or more SIRS criteria and suspicion of new infection.

Moreover, if the ED patients have been detected with positive screen to sepsis, further investigations were ordered by ED physicians to the ED nurses for the source of infection such as obtaining blood cultures and serum lactic tests, which were the most common diagnostic procedures for sepsis. In addition, the assessment for sepsis was performed along with identification of sepsis process. For example, if the patient arrived at the ED with acute altered mental status, CAM was assessed to differentiate delirium with dementia, often found in elderly adults. Another example for assessment could be evaluated patients with fluctuation of vital signs who were at higher risk. This means reassessing the vital signs, reviewing all data and keeping on documenting patient's condition. Lastly, none of the articles has mentioned about measuring blood pressure in the initial phase of triage. All articles were following only SIRS criteria to detect positive screening to sepsis.

Consequently, the author has determined clearly during findings phase to identify and assess patient's sepsis by nurses in the ED prior to sepsis screening tool was participating in the performance improvement program, which includes education, protocol development and implementation, data collection, measurements of indicators and relaying feedback to interdisciplinary team and others as well. After that, ED nurses should proceed with sepsis screening tool and sepsis care bundles in the collaboration with ED physicians. Furthermore, PSAG board should be implemented by ED nurses to record patient condition with NEWS trigger points and SIRS criteria plus each observation documents to prevent sepsis related complications and mortality.

Additionally, to promote this area effectively, SBAR communication between ED nurses and physicians plays dominant role to save patient's life. Finally, the articles have mentioned that the reliability can be obtained via awareness in the systems; communication within the team and initiating comprehensive and multidisciplinary response during the early stage of deterioration and one article has determined reliability by implementing

NEWS at the triage time. Therefore, the author has discovered a few additional elements together with sepsis screening tool to identify and assess patient sepsis in the ED by nurses. Moreover, to illustrate the additional elements, the author has developed sepsis identification tool showed in Figure 1 (APPENDIX 3).

According to the reviewed articles, the author has identified that the participants have significant knowledge deficits regarding recognition of several key areas of SIRS/sepsis identification and patients in early stages of the sepsis continuum. Additionally, the most evident parts where nurses and physicians undiagnosed and unnoticed were serum lactate acid test and assessing vital signs frequently, especially blood pressure measurement. Thus, the development and implementation of a written triage protocols would be very helpful to identify and manage patients with sepsis as similar to the management of acute coronary syndrome, stroke and pneumonia, which have been already functioned in the ED. A written triage protocol should consists of SIRS criteria (physiological and laboratories criteria) and diagnostic criteria for sepsis to prompt early recognition. Moreover, ED nurses should be provided in-service educational trainings on both sepsis protocols and physiology about answering the how and the why; they were beneficial in initial stage of identification and assessment of sepsis in patient. Nevertheless, nurses were the core health professionals to recognize and document subtle changes in the vital signs and to accomplish the often lengthy workup by identifying sepsis rapidly. This indicates that the patients will be received early sepsis resuscitation and aggressive treatment immediately and reduced in its complications.

The author has chosen particularly emergency department because there were no restriction of age bar in this unit and patients of any age are allowed in the ED at their triage time and always nursing staffs confronted with such patients who seek immediate medical attention. Therefore, ED nurses should be competent enough to perform their task efficiently and also patients must be fully satisfied with their treatment received from nurses. The fact of ED is that it is always a crowded place, where nurses are busy performing their different tasks at a time. Sometimes, due to sudden medical urgencies like in huge natural disaster or accident cases those who arrived in the ED could not receive holistic treatment. Hence, during this phase, ED nurses are unable to follow the sepsis guidelines in the beginning and its consequences are higher than expected such as within an hour patient's condition has drastically deteriorated to lethal. This can be generated due to certain barriers

such as less experience of ED nurses or novice nurses or difficult to change cultures for more experienced ED nurses. Thus, the ED should organize and provide education, training sessions and in-the-job program of sepsis for ED nurses in sequential manner before and after joining ED such as formal and informal meetings among ED staffs from top management worker to low management worker, it means sepsis information must be a flow or communication among the co-workers.

In conclusion, this particular research project with the author's discovered sepsis identification tool was an influential and relevant topic to promote clinical nursing field. Moreover, it could be significantly practicable in the acute health care settings implemented via acute/critical nurses. However, the further recommendations of study would be quantitative research associated with group ED nurses interviewing regarding the knowledge of sepsis and its management. Thus, this indicates that such target groups could be framed concrete outcomes based on statistics.

6.4 Implication to Emergency Nurses

ED nurses should thoroughly follow the sepsis protocol to identify and evaluate sepsis early. Moreover, ED nurses should not only dependent on the resources that were provided by technicians' intervention and physicians medical examinations but also nursing interventions should be taken into account to improve the outcomes for patient with sepsis. Such as routine documentation of monitoring urine output, antibiotic therapy within 1 hour and obtaining blood for culture and serum lactate measurement prior to antibiotic administration. Finally, the ED nurses task was not only to recognize the signs and symptoms of sepsis; however they acquired knowledgeable information about the necessity of the prompt and aggressive treatment of the syndrome. Therefore, only one rapid ED nurse's action may save patient's life.

6.5 Author's Learning Process

As a reflection, this research process provided the authors an excellent and a great learning experience. The thesis process enhanced the understanding of the difference between nursing literature review and nursing science. Moreover, the author learned how to appreciate the work of nursing professionals and to search for evidence-based nursing journals. Also, the process taught the author about time management, maintaining transparency and justifying nursing related decisions via in-depth reading of the articles. Consequently, the authors gained wider perspective to promote critically ill patient with sepsis through core knowledge of sepsis continuum and its managements.

7 CONCLUSION

ED nurses play curial role and prime position in the early recognition, diagnosis and treatment of sepsis. To conclude, the sepsis screening tool and sepsis care bundles were implemented in the ED to identify and assess patients with sepsis by nurses. The ED nurses enhanced nursing intervention in the areas of identification of patient sepsis via prior participating in performance improvement program such as education for sepsis, protocol implementation and development, data collection, measurements and indicators, ongoing feedback and suggestions to the physicians, nurses educators and other healthcare professionals and maintaining good interpersonal relationship among multidisciplinary team with SBAR communication implementation and PSAG tool. Thus, it reduced the morbidity and mortality rate and saves patient life on time.

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TABLE 1. Variables and score value for track and trigger scoring (adapted from Daniels & Nutbeam 2009)

Score	3	2	1	0	1	2	3
Respiratory rate		< 8		9-19	20-22	23-30	> 30
SpO_2 %	< 88	88-89	90-95	≥ 96			
Heart rate	< 40	40-49	50-89	90-109	110-129		>130
Systolic BP	< 70	70-79	80-99	100-199		> 200	
Urine output	Nil	<20ml/hr	<30ml/hr				
CNS		Confused		Alert	Voice	Pain	Unresponsive
Temperature		< 35	35-35.9	36.0-37.2	37.3-38.2	≥ 38.3	

TABLE 2. Example of calculating variables for track and trigger scoring according to the table 1 (adapted from Daniels & Nutbeam 2009)

Respiratory rate	22	Score 1
SpO_2	96%	0
Heart rate	105	0
Systolic BP	90 mmHg	1
Urine output (Just admitted)	unknown	0
CNS	voice	1
Temperature	38.2^0C	1
	Total	4

TABLE 5. Articles included in the literature review

	Authors, Year, Topic & Journals	Aim of Research	Method of Research	Main Results of the Research
1.	Bohm, K., Kurland, L., Bartholdson, S. & Castren, M. 2015. Descriptions and Presentations of Sepsis – A Qualitative Content Analysis of Emergency Calls. International Emergency Nursing.	To explain the descriptions and presentations of sepsis used during the communication between the caller and the emergency medical dispatcher.	Qualitative Content Analysis (inductive approach)	The study has determined three main categories extracted from fifteen subcategories. They were deterioration, physical signs and symptoms and difficulties establishing satisfactory contact with the patient. Additionally, the descriptions of sepsis expressed by the laymen and professionals were different. As consequences, the article found the most common symptoms in septic patient were respiratory distress and lower level of consciousness.
2.	Bruce, R. H., Maiden, J., Fedullo, F. P. & Kim, C. S. 2015. Impact of Nurse-Initiated ED Sepsis Protocol on Compliance with Sepsis Bundles, Time to Initial Antibiotic Administration, and In-hospital Mortality. Journal of Emergency Nursing.	To analyze the impact of a nurse-initiated ED sepsis protocol on time to initiate antibiotic treatment, confirm compliance within 3 hours SSC targets and determine predictors of in-hospital sepsis mortality.	Retrospective chart review (Quantitative research)	The studied has demonstrated serum lactate level and median time to initial antibiotic therapy were improved after implementing SSC protocol by around 15% and 27 minutes respectively. Moreover, the significant predictors of in-hospital mortality were respiratory distress, CNS dysfunction, UTI, vasopressure therapy and patient body weight. Therefore, the results of the study have suggested that more importance should be provided on the critically ill patients and ensured that they received early screening and timely sepsis management according to the SSC guideline.

| 3. | Burney, M., Underwood, J., McEvoy, S., Nelson, G., Dzerba, 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. | To identify and address specific barriers at the institution and maximize benefits of a planned sepsis treatment initiative via performing a baseline assessment of knowledge, attitudes and behaviors regarding early detection and treatment of severe sepsis. | Cross-sectional design (Online survey Quantitative research method) | The results showed that a written protocol would be very helpful to respondents (nurses and physicians) to identify early detection for sepsis. Moreover, barriers included the inability to perform monitoring of central venous pressure/central venous oxygen saturation, lack of sufficient nursing staff and limited physical space in the ED. Among nurses, the greatest delays in treatment were delays in diagnosis by physicians. Whereas in physicians, the greatest barriers were a delays in availability of ICU beds and nursing delays. Finally, both health professionals were pointing each others, which were the main barriers for recognizing the sepsis. |
| 4. | Bushnell, L. K., Demaray, S. W. & Jaco, C. 2014. Reducing Sepsis Mortality. Medical Surgical Nursing. | To reduce the mortality related to sepsis. | Literature review | Nurses were able to identify patients with sepsis, obtain laboratory tests and promptly initiate management for sepsis. This was possible only by strictly following nursing sepsis protocol developed by the SMITe and staff educators. Finally, the study has explained that after implementing sepsis protocol for over 4 years, the project has gained tremendous success by reducing mortality by over 50% in more than 400 patients and treated successfully for sepsis. |

5.	Dumont, L. & Harding, D. A. 2013. Development and Implementation of a Sepsis Program. Journal of Emergency Nursing.	To develop and implement a sepsis program in Southcoast Health system hospitals for early recognition of sepsis and to reduce the mortality rate related to sepsis.	Survey method (literature review)	The sepsis program consists of ED sepsis order set, education (formal/informal to nurses and physicians), sepsis screening tool and placement of patients. Furthermore, the study has developed ED nursing compliance with sepsis screening, which was measured and completed within 30 minutes from the initial recognition of SIRS criteria.
6.	Fleming, F. P., Forster, D., Savage, T., Sudholz, H., Jacobs E. S. & Daley, J. A. 2011. Evaluating Suspected Sepsis in Term neonates. Journal of Neonatal Nursing.	To detect the proportion of healthy term neonates assessed for suspected sepsis.	Retrospective audit/study (Quantitative research)	The most common clinical sign found during the assessment of suspected sepsis was 38% of respiratory distress in the neonates. Moreover, evaluation to rule out sepsis consists of blood culture plus acute laboratory markers (blood total count tests and CRP) those were analyzed in the diagnosis of early onset of sepsis. Consequently, serial CRP and Procalcitonin were determined well than normal CRP for effective results.
7.	Hancock, C. 2014. A National Quality Improvement Initiative for Reducing Harm and Death from Sepsis in Wales. Intensive and Critical Care Nursing.	To improve quality and service of RRAILS programme that was participated by Welsh healthcare organizations including the Welsh Ambulance Service Trust (WAST) and Velindre Cancer Centre.	Collaborative learning set (Literature review)	Implementation of standardized tools in all health organization such as NEWS, sepsis screening tools, PSAG boards, sepsis response bags and an antibiotic treatment. Thus, these interventions had improved in the reliability of detection and escalation of acute deterioration in patient with sepsis.

8.	Jeffery, D. A., Mutsch, S. K. & Knapp, L. 2014. Knowledge and Recognition Of SIRS and Sepsis among Pediatric Nurses. Pediatric Nursing.	To assess the knowledge of acute and critical care pediatric nurses of SIRS diagnostic criteria, sepsis guidelines and the importance of SIRS recognition.	Cross-sectional, quantitative and correlational descriptive study.	Nurse participants easily recognize septic shock but had difficulty identifying patients in the earlier stages of the sepsis continuum. Moreover, nurses had poor knowledge regarding SIRS and sepsis diagnosis criteria recognition.
9.	Kent, N. & Fields, W. 2012. Early Recognition of Sepsis in the Emergency Department: An Evidence-based Project. Journal of Emergency Nurses.	To implement a sepsis screening measure for improving the early identification, communication and treatment of patients with sepsis.	Descriptive statistics study (Quantitative research)	The severe sepsis screening measure was simple to use and it provides ED nurses clear direction for assessing specific signs or presentations in septic patient. Moreover, it contributed the nurses' specific terminology and scripting to communicate the physician when recommending additional examinations or treatment.
10.	Kleinpell, R., Aitken, L. & Schorr, A. C. 2013. Implications of the New International Sepsis Guidelines for Nursing Care. American Journal of Critical Care.	To analyze the role of critical care nurses via over-viewing the new evidence-based recommendations from SSC guidelines for the treatment of adult patients with sepsis.	Literature review	In the SSC guideline, for most important part was the early recognition, assessment and diagnosis of sepsis that help critical nurses to ensure prompt treatment to reduce the sepsis-related mortality rate. In addition, the article has highlighted the implications of the new International SSC guidelines to provide latest updated evidence-based practice recommendations that help to promote best practices for patient care.

11.	Makic, B. F. M. 2013. Surviving Sepsis Campaign Guidelines Update 2012: What Does it Mean for Perianesthesia Nursing? Journal of Perianeathesia Nursing.	To determine how perianesthesia nurses recognize septic patients.	Literature review	The article has showed that perianesthesia nurses can identify surgical patients who were at risk for sepsis via sepsis screening tool and also implement strategies to prevent infection such hand washing, surgical site infection prevention, catheter associated UTI prevention and ventilator-associated event prevention interventions.
12.	Moss, D. 2014. A Screening Tool for Early Recognition and Treatment of Sepsis. Virginia Henderson, Global Nursing e-Repository.	To investigates the use of a sepsis screening tool to reduce the length of time from triage to treatment.	Observation study (data was evaluated using descriptive statistics and Welch t-tests) chart reviews and the sepsis screening tool.	The implementation of sepsis screening tool reduced the time in triage to treatment from 29.2 minutes to 15.5 minutes. Hence, it had great impacts on the morbidity and mortality of septic patients.
13.	Robson, W. & Daniels, R. 2013. Diagnosis and Management of Sepsis in Adults. Nurse Prescribing Journal.	To investigate the diagnosis and management of sepsis in the adult patients from nursing view points.	Literature review	The article has explained that the rapid identification of sepsis via EWS including sepsis screening tool can excessively improve the management of sepsis and decreased sepsis related complications.

14.	Suberviola, B., Lopez, M. A., Ortega, C. A., Mazarrasa, F.C., Santibá-ñez, M. & Martinez, M. L. 2016. Microbiological Diagnosis of Sepsis: Polymerase Chain Reaction System Versus Blood Cultures. American Journal of Critical Care.	To compare the PCR and blood cultures for detecting bacteria and fungi in blood samples from patient with sepsis.	Prospective observational study (Quantitative research)	The SeptiFast investigated at least 1 microorganism being isolated at 6 hours was 13-fold higher than with blood cultures. The results from SeptiFast were not affected by consumption of antibiotic. The median time to the first positive blood culture result was 17 hours, whereas SeptiFast results time was only 6 hours. Additionally, SeptiFast determined genetic material from potentially multiresistant microorganisms in sepsis suspected patient, whose blood cultures showed no growth at all.
15.	Turi, K. S. & Von, D. 2013. Implementation of Goal-Directed Therapy for Septic Patients in the Emergency Department: A Review of the Literature. Journal of Emergency Nursing.	To review the literature regarding the implementation of the sepsis guidelines in ED.	Literature review	The study had discussed about the collaboration, preplanning and education among the nurses to implement monitoring of CVP, mean arterial pressure and $ScvO_2$. Nonetheless, it has had determined sepsis nursing interventions, as it was often considered less in measuring urine output and obtaining blood cultures.
16.	Vanzant, M. A. & Schmelzer, M. 2011. Detecting and Treating Sepsis in the Emergency Department. Journal of Emergency.	To detect and treat sepsis in the ED in systematic ways.	Literature review	The sepsis was detected via four strategies. They were serum lactate levels, SIRS criteria, ten vital symptoms of body function and assessing changes in cognitive function. If the ED patients were detected sepsis with such strategies, they were soon treated with EGDT.

Performance Improvement Program

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Sepsis Screening Tool + Sepsis Care Bundle
NEWS+ SIRS criteria (BP)   (Antibiotic therapy, O_2 delivery, IV fluids
+ Source of Infection   intervention, taking blood samples for
                                         Cultures and serum lactate measurement
                                         and monitoring urine output)

CRP serial
Serial serum lactate
Procalcitonin
SeptiFast

↑
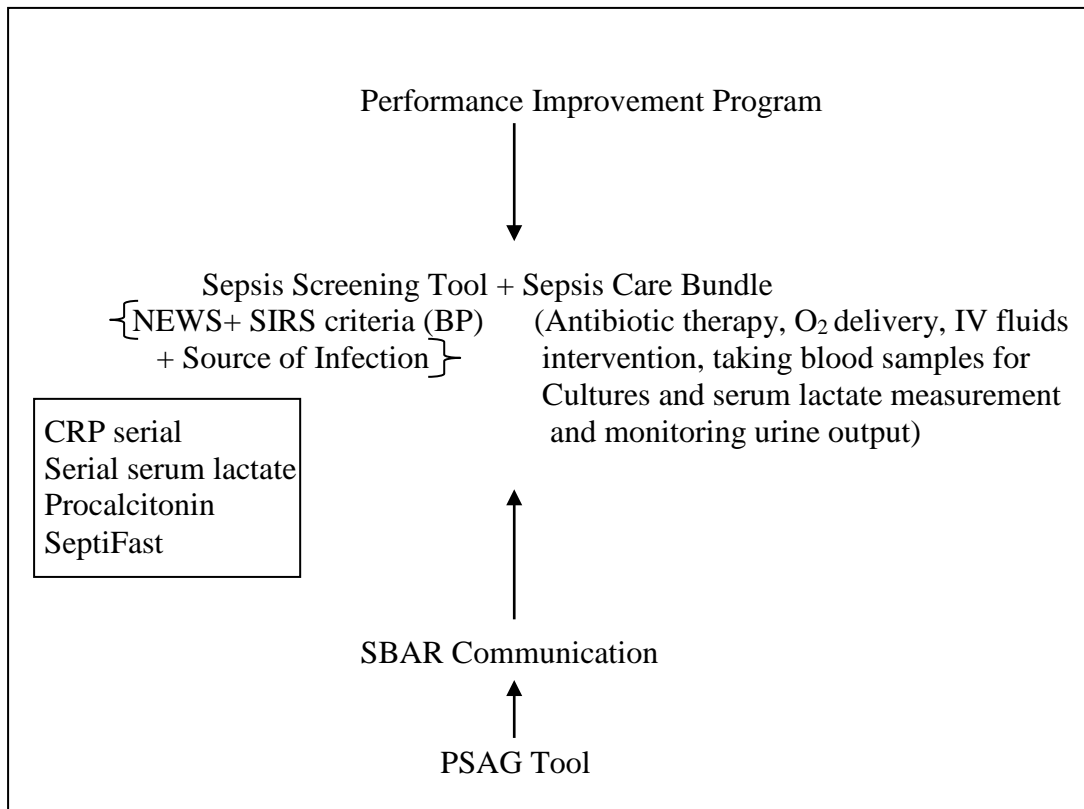
SBAR Communication

↑

PSAG Tool

FIGURE 1. Sepsis Identification Tool (Adapted from Kleinpell et al. 2013; Hancock 2014)