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Maternal Sepsis: A Standardized Approach

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Abstract

Maternal sepsis is the fourth leading cause of maternal death in the US (Olvera & Dutra, 2016). The majority of deaths due to maternal sepsis are related to a delay in identification and treatment of sepsis. The goal of this maternal sepsis project was to develop a policy where all patients in the perinatal units at the site hospital are being screened for sepsis and if sepsis is identified, then the patient is treated according to best practice. The Surviving Sepsis Campaign (SSC) has guidelines for treatment of sepsis, but these guidelines were not being followed at the site hospital. Nurse's knowledge was assessed in regards to maternal sepsis in a pre and posttest during an educational class on maternal sepsis and the new policy. A electronic medical record (EMR) maternal sepsis screening assessment was implemented and required by nurses to fill out on every patient. The assessment notifies nurses if the patient screens positive for sepsis so that the physician can be notified and order the recommeneded treatment protocol. The results of the project show that nurses did increase their knowledge on maternal sepsis after the required educational class. The audits of the maternal sepsis assessment showed that proper and timely treatment of maternal sepsis occurred in four out of the five positive cases one month after implementation. In the one fall-out case, the antibiotics were delayed by thirteen minutes.

Keywords: maternal sepsis, obstetric sepsis, sepsis in the pregnant patient

Maternal Sepsis: A Standardized Approach

Maternal sepsis is a national health concern and is the leading cause of maternal death worldwide and in the United States (US), ranking among the top four maternal mortality reasons (Vaught, 2018). Worldwide, there are an estimated 62,000 or more deaths on a yearly basis as a result of maternal sepsis (Bolger, Rhodes, & Coward, 2017). Maternal sepsis deaths have increased over the last 15 years in the US and from 1998-2008, the sepsis-related deaths in the US doubled (Bauer et al., 2014). Sepsis is not a new concept and yet more pregnant women are dying from the disease each year (Bauer et al., 2014).

Increases in maternal sepsis related deaths have led to studies focused on identifying contributing factors. A study by Ford and Scholefield (2014) found that there were three main substandard care factors commonly associated with maternal death. These factors included: failure to recognize and respond to the sick woman, failures with antibiotic therapy, and failure to manage fluid balance appropriately (Ford & Scholefield, 2014). Delays in response can be due to the fact that maternal efforts during second stage of labor, interventions during labor, or blood loss after delivery can all obscure the signs and symptoms of infection (Bonet et al., 2017). If response is delayed, for whatever reason, septic shock can develop, leading to severe hypotension, inadequate perfusion, widespread injury at the cellular level, ischemia, and organ dysfunction (Parfitt, Bogat, Hering, Ottley, & Roth, 2017). Early identification and management of sepsis is key to improving patient outcomes (Rhodes et al., 2017).

The pregnant woman is more at risk for infections and illness due to immunological changes associated with pregnancy. Immunological defenses are lowered in order to protect the fetus (Olvera & Dutra, 2016). There are numerous infections during pregnancy that are common, but even a seemingly uncomplicated urinary tract infection may lead to sepsis if left

untreated. Other relatively common infections or procedures during pregnancy that can lead to sepsis include: abortion, chorioamnionitis, retained products of conception, cerclage, operative delivery, cesarean delivery, mastitis and/or endometritis (Faksh & Martin, 2016). Some of the infections are rare, but others are not. For example, chorioamnionitis can happen in approximately 1-5% of term pregnancies and 25% of preterm deliveries (Olvera & Dutra, 2016). Nurses and other health care providers must be educated on the signs and symptoms of sepsis and treatment guidelines so that the sepsis does not progress to organ failure and untimely death. Maternal sepsis may not be preventable, but death from the illness can be avoided if sepsis is diagnosed and treated rapidly (Olvera & Dutra, 2016).

Background

Sepsis is defined as "a life-threatening organ dysfunction caused by a dysregulated host response to infection" (Tavare & O'Flynn, 2017, p. 185). In earlier centuries, it was common for a woman to die from an infection and many women died for unknown reasons during labor. It is now believed that many of these cases of death were probably due to sepsis (Bolger et al., 2017). As healthcare improved and antibiotic treatments were discovered, the large number of maternal sepsis epidemic cases decreased. In the last 30 years, the cases have reappeared and increased again (Bolger et al., 2017). Maternal sepsis, although not well defined in the literature, is essentially the same definition as sepsis with the addition that it occurs during pregnancy, birth, or post-partum (Olvera & Dutra, 2016). Sepsis is a serious condition and if left untreated can lead to septic shock and death. This progression from systemic inflammatory response (SIRS) to severe sepsis and shock can progress rapidly and for this reason, early identification and management of sepsis can decrease the risk of morbidity and mortality (Olvera & Dutra, 2016).

The National Institute for Health and Care Excellence (NICE) published guidelines for the recognition, diagnosis, and early management of sepsis for children through adults. These guidelines are not specific and do not address the physiological changes women experience during pregnancy. If the following guidelines were applied to pregnant women, most women would screen positive for sepsis (Tavare & O'Flynn, 2017). During pregnancy, the blood pressure decreases by 5-10 mm Hg, the heart rate increases by 17%, and leukocytes increase by 17-30/uL in the third trimester (Albright et al., 2014). Little is known about pregnancy and lactic acid, but this laboratory (lab) test is still used to confirm infection processes (Albright et al., 2014). In addition, the Surviving Sepsis Campaign (SSC) was developed in 2004 and contains a guideline for physicians to recognize and treat sepsis. This campaign introduced a bundle of interventions that has shown to improve patient outcomes and is updated every couple of years, with the last update in 2018. Obstetric (OB) providers did not accept the guidelines from this campaign as the criteria was not applicable for pregnant women (Albright et al., 2014). Since the development of the SSC, obstetricians and maternal healthcare professionals have been trying to determine set guidelines or bundles for the pregnant woman. There has since been some consensus on vital sign changes and identification factors, but the guidelines vary from researcher to researcher, as opposed to the SSC for adult sepsis, no formal bundle exists for OB care (Albright et al., 2014). The main consensus for changes has been to increase the heart rate to 110 bpm and white blood cells (WBC)s to 15,000 or higher for the laboring patient (Olvera & Dutra, 2017). These guidelines are from the Association of Women's Health, Obstetrics and Neonatal Nurses (AWHONN) recognition and management of maternal sepsis study and are used as guidelines by many other research studies (Olvera & Dutra, 2016). Some obstetricians feel fetal tachycardia should be included in the recognition signs and symptoms for maternal

sepsis and some do not include fetal tachycardia (Albright et al., 2014). One thing that is agreed upon is treatment methods as they are the same for any case of adult sepsis whether or not the woman is pregnant (Rhodes et al., 2017).

The first step of diagnosing sepsis in the adult population is having a positive systemic inflammatory response syndrome (SIRS) screen, however, if used in the obstetric population as is, many women would be diagnosed with sepsis and may be inappropriately treated. SIRS criteria for the adult population includes a temperature greater than 38 degrees Celsius, heart rate greater than 90 beats per minute (bpm), respiratory rate greater than 20 breaths per minute, and WBC count greater than 12,000 (Faksh & Martin, 2017). If a patient meets two-criteria, they are considered to have a positive SIRS screening. If a person has a positive SIRS screen and has a presumed or confirmed infectious process, then they are diagnosed with sepsis, which can lead to severe sepsis and then septic shock if untreated or failed treatment (Faksh & Martin, 2016). Some of the differences in the cardiovascular system of a pregnant woman include a heart rate of greater than 100 bpm, PCO2 at 32-34 mmHg and WBCs commonly 14,000 – 30,000 (Vaught, 2018). Normal physiological changes of pregnancy would give the patient a positive SIRS screen as written. For these reasons, a maternal sepsis protocol needs to be adapted that will be reliable for the pregnant woman. Lack of definitions, protocols and guidelines can lead to delay in diagnosis and treatment of infection and allow sepsis to progress on the continuum towards organ failure (Vaught, 2018). Many protocols exist and are very similar in criteria; the importance would be getting physician buy-in to implement the protocol. Using the AWHONN recognition of sepsis guidelines would be beneficial as many obstetricians trust the studies and research done by AWHONN, then the group can choose to add or omit items, such as fetal tachycardia, to their protocol. The importance lies in the education of maternity staff of the signs

and symptoms of maternal sepsis and a protocol for treatment once suspected (Bolger, Rhodes, & Coward, 2017).

Although most of the discussion of maternal sepsis will revolve around the mother and maternal implications, the unborn fetus is also at risk of complications from maternal sepsis. Cytokines and chemokines released during maternal sepsis can cross the placenta and cause a fetal inflammatory response syndrome, which can lead to issues on fetal organ system development (Faksh & Martin, 2016). Neonates born to women who have some infection processes going on inside their bodies can develop early-onset neonatal sepsis [EOS], (Bonet et al., 2018). As with maternal sepsis, if EOS in the neonate is not identified in a timely manner the baby can die. The prevelence of lab-confirmed neonatal infection when the mother had a confirmed infection is approximately 15% (Bonet et al., 2018). Mortality rates of EOS in neonates can reach 3% in term neonates and 15% in preterm neonates (Bonet et al., 2018).

Risk factors for maternal sepsis are numerous and include: older age, less than high school education, public or no insurance coverage, caesarean section, racial and ethnic minority status, first pregnancy, multiple gestation, low hospital birth volume, diabetes, obesity, chronic hypertension, and a history of either preeclampsia or a postpartum hemorrhage (Faksh & Matrin, 2016). Many pregnant women will have at least one of these risk factors. The risk factor low hospital birth volume is significant in that it shows that hospitals that do not have high volumes of delivery will put the mother at risk for maternal sepsis, possibly due to the fact that the staff may be less likely to identify maternal sepsis. It can be assumed this fact shows the importance in staff education at all levels, especially low volume birth hospitals. Additional risk factors described by Ford and Scholefield (2014) include anemia, impaired glucose tolerance, and impaired immune response.

Problem Statement

Maternal sepsis is the fourth leading cause of maternal death in the US (Olvera & Dutra, 2016). When you combine maternal mobidity and mortality, maternal sepsis is the leading cause in the US and worldwide (Faksh & Martin, 2016). In addition, if a patient survives maternal sepsis, the associated morbitities are costly and many times emotionally difficult to overcome for new mothers. Maternal sepsis has increased over the years and we need a way to identify it and provide early treatment so women do not die from the illness. The majority of maternal sepsis cases lead to some type of morbidity for the patient and usually an extended hospital stay that includes days in the intensive care unit (ICU), which all costs the hospital, the patient, and the community money.

The SSC has outlined a treatment bundle, that when implemented, has proven to decrease mortality in the non-obstetric patient (Faksh & Martin, 2016). However, studies have not been performed or researched on the obstetric patient, the treatment recommendations are the same. Management of sepsis include: antibiotic therapy, blood cultures obtained before administration of the antibiotic therapy, lactate level, and volume resuscitation all within three hours (Faksh & Martin, 2016). To improve maternal and neonatal outcomes or if severe sepsis or septic shock is recognized, antibiotic therapy should be initiated within one hour (Dellinger et al., 2012; Faksh & Martin, 2016; Padilla & Palanisay, 2017). During the 2018 update to the SSC, it was recommended that all resuscitation and management begin immediately and so the previous 3-hour bundle and 6-hour bundle have been changed to a single 1-hour bundle (Levy, Evans, & Rhodes, 2018). Research has shown the delay can lead to increased morbidity, many of which are irrevesrible and so the bundle has changed to reflect the urgency (Levy et al., 2018).

Due to this special subset population of sepsis patients, several researchers have developed different obstetric triggers and bundles related to maternal sepsis. These can be useful when developing a maternal sepsis protocol. Aror et al. (2016), states that having a trigger, bundle, protocol or checklist aids to improve quality of care and timely diagnosis and treatment to limit severity of morbidity. There are different trigger tools available in the research, one of which are the maternal early warning criteria (MEWC) and modiefied early obstetric warning system [MEOWS] (Shields, Wiesner, Klein, Pelletreau & Hedriana, 2016). These and others, although not specific to sepsis, allow providers to identify when there may be maternal issues or differences so further research can be done on the patient. The items in these trigger tools can be added to an alert system in the electronic medical record to make it easier for proviers to know when they need to escalate care.

In order for treatment of sepsis to be started, there needs to be a way for nursing staff to identify that a patient may be at risk for sepsis. This can be done by a shift assessment that can screen a patient for positive signs of infection or sepsis, if a patient has a positive screen, then the medical team can be notified and the appropraite labs can be drawn to confirm infection or sepsis. If identified, treatment must be started rapidly. With the technology of the electronic medical records (EMR)s in most hospitals today, an assessment that screens the patient can easily be added and required by nursing staff to complete. The project site has no way of identifying patients at risk or a protocol for treating those who may have maternal sepsis.

Purpose Statement

The aim of this project is to develop a method to identify early maternal warning signs of maternal sepsis in order to expedite treatment and management of patients. A policy and protocol will be developed at the hospital site to help guide nursing and physician practice so that

all patients with suspected sepsis will be identified and treated equally. The EMR will be utilized to help with assessment and identification of signs and symptoms of the sepsis continuim. When a patient has a positive screening in the EMR, further tests and labs as suggested by the SSC will be initiated on a case-by-case basis. Staff education and simulation will be added after the protocol is developed prior to implementation. The maternal sepsis protocol will help with early identification, treatment and management of sepsis.

Project Question

Using the PICOT format, population, intervention or influence, comparison, outcomes and timeframe, is one way of developing a project question. With the project at hand, the population is pregnant women in all three trimesters of pregnancy and up to eight weeks postpartum because all have a risk of developing maternal sepsis. The intervention is developing a protocol that includes assessment and alerts in the electronic record to identify infection risk. Comparison is to current practices where there is no policy or protocol and the outcome is timely identification and treatment of suspected maternal sepsis cases. The timeline can also be included as part of the project question, and this project is anticipated to take two months to develop and implement and two months for education around the new protocol. The project question: Does having a maternal sepsis protocol help with early identification and treatment of maternal sepsis on the perinatal units?

Project Objectives

The objectives of the project include the following:

1. Develop and implement a maternal sepsis protocol based on best practice in the practice site L&D and postpartum (PP) unit.

2. Implement an assessment and alert system in the EMR to identify maternal sepsis or infection and alert staff.
3. Improve knowledge levels of L&D and PP unit staff on early identification and management of early maternal sepsis by hosting an educational class for staff and providers on maternal sepsis and the protocol, evaluating beginning and ending knowledge of participants
4. Improve early management and treatment of maternal sepsis cases to meet 1 hour bundle times.

Significance

Although maternal sepsis only affects 0.002% to 0.010% of pregnancies, it accounts for 15% of the maternal deaths, most of which are preventable (Olvera & Dutra, 2016). The hospital site chosen for the doctor of nursing practice (DNP) project currently has a sepsis policy in place for adult patients who enter through the emergency room (ER), as well as a 'code sepsis' protocol in the ER for anyone who is identified as sepsis screen positive. This policy however, does not address maternal sepsis, which manifests differently than non-pregnant adult sepsis (Parfitt et al., 2017). At the hospital site all pregnant patients over 20 weeks gestation are seen on the L&D unit. The L&D unit does not have a sepsis policy or protocol in place, provide education for staff, or have an assessment specific to infection or sepsis identification; all of which are recommendations for safety in OB units (Olvera & Dutra, 2016). Knowing that sepsis is one of the top four causes of maternal death in the US, there needs to be a way to screen patients for this illness and treat early to prevent mortality (Parfitt et al., 2017). In addition to a screening assessment, an educational program for nurses and physicians is needed to teach the importance of identification and how to identify patients at risk, as well as the protocol and

treatment régime. Educating professionals on the signs and symptoms of early recognition of maternal sepsis will decrease maternal mortality (Olvera & Dutra, 2016; Padilla & Palanisamy, 2017).

Search Terms

Using the PICOT question format, the search term 'maternal sepsis' was used in the EBSCO host database, limiting the results to English, full text and within the past five years, there was 17,609 results generated. To make the search more manageable, the search phrase was changed to be included in the title of the article and that yielded 120 results. Other search terms used and required in the title of the article included: sepsis and obstetrics, which generated 50 results with the same criteria, and maternal sepsis and guidelines resulted in one article. A search of maternal sepsis and management with the same guidelines generated 19 articles on an Elton B. Stephens Company (EBSCO) search. Half of these articles were duplicates that had resulted in other searches. A search for maternal sepsis and recognition generated only four results, three repeats from the general search and one article that was from the country Suriname and did not apply. Maternal sepsis and education resulted in eight articles. Repeat articles were excluded from the literature. Abstracts were utilized to select or eliminate articles to development and implement a sepsis protocol and staff education. Twenty-seven articles met criteria of being within the last five years and proved to be helpful in implementing a guideline in relation to maternal sepsis and education for staff. Articles that focused on adult sepsis or pediatric sepsis were not used. Articles that pertained to guidelines, but not in the US were excluded.

Review of Literature

Several themes emerged in the literature review including: early identification and treatment of maternal sepsis and staff and patient education (Bauer et al., 2014; Bonet et al.,

2017; Ford & Scholefield, 2014; Olvera & Dutra, 2016; Padilla & Palanisamy, 2017; Tavare & O'Flynn, 2017). A few studies have been conducted on maternal warning signs that indicate the patient is at risk for sepsis or in the sepsis continuum, and some articles studied bundles that can be put together for treatment of maternal sepsis as recommended by the SSC readdressed in 2018.

Impact of the Problem

Approximately 70% of the deaths from maternal sepsis in the US were due to a delay in diagnosis (Bonet et al., 2018; Ford & Scholefield, 2014; Padilla & Palanisamy, 2017). There are systems in place to identify abnormal findings in a pregnant woman, such as MEWC, but these criteria are not specific to maternal sepsis (Padilla & Palanisamy, 2017; Shields et al., 2016). Padilla and Palanisamy (2017) explain that the criteria for MEWC, which includes temperature >38.1 Celcius, respiratory rate >25/min, heart rate >107 bpm and WBCs >18,000 indicate abnormal findings for pregnancy and further interventions are required. This screening tool, along with many others for obstetrics, have high false positive rates, but do screen for abnormal signs and symptoms (Bonet et al., 2018; Padilla & Palanisamy, 2017). The Institute of Healthcare Improvement (IHI) encourages the use of bundles and sets of evidenced-based interventions because they have significantly improved outcomes when compared to individual interventions (Albright et al., 2014; Arora et al., 2016; Shields et al., 2016).

Addressing the Problem with Current Evidence

Prevention. Maternal sepsis is highly preventable and there are known ways to decrease a woman's risk, including access to clean water, access to quality care during pregnancy, responsible and timely access to the right medications, and proper infection control and prevention methods in hospitals (World Health Organization [WHO], 2018). Pregnant women

are more susceptible to infections due to decreases in immunity to protect the fetus (Bonet et a., 2017; Padilla & Palanismay, 2017). In order to decrease deaths from maternal sepsis there is a need to provide quality care and have the knowledge to recognize early warning signs and symptoms to expedite treatment (Bauer et al., 2014; Bonet et al., 2017; Ford & Scholefield, 2014; Olvera & Dutra, 2016; Tavare & O'Flynn, 2017).

Current management. Currently, the management of maternal sepsis and adult sepsis are the same. The differences between the two are in identification based on vital signs and behaviors (Albright et al., 2014; Bauer et al., 2014; Ford & Scholefeild, 2014; Olvera & Dutra, 2016; Tavare & O'Flynn, 2017). The SSC is the national guideline for treating sepsis and updated its treatment recommendations in 2018 (Levy et al., 2018). The new treatment guidelines from 2018 changed the previous three-hour and six-hour treatment bundles into a single 'hour-1 bundle' where resuscitation and management is started immediately (Levy et al., 2018). More than one hour may be required to complete treatment, but the new guidelines stress the importance of starting treatment and resuscitation efforts within the first hour after identification. Also included in the one-hour bundle is drawing blood for a lactate level, obtaining blood cultures, administration of fluid and antibiotics, and vasopressor therapy if needed (Levy et al., 2018). Time zero or time of presentation is the earliest documentation that the patient has elements of sepsis or septic shock (Levy et al., 2018). These recommendations for treatment do not change because the patient is pregnant; once sepsis or septic shock is suspected or identified, treatment must be started in an attempt to save the life of the mother and her fetus (Faksh & Martin, 2016; Olvera & Dutra, 2016). In certain cases, if the mother and/or the fetus are compromised, a decision for rapid delivery may be made. However, this is a case by case decision by the attending obstetrician (Faksh & Martin, 2016; Ford & Scholefeild, 2014).

Delivery will not cure or stop the sepsis, but it may make treatment of the mother easier and lead to less complications of the fetus than if it remains in a compromised environment (Faksh & Martin, 2016). In the event of a mother requiring ventilator support, a cesarean section should be considered (Faksh & Martin, 2016; Ford & Scholefeild, 2014; Olvera & Dutra, 2016).

AWHONN's early recognition and management of maternal sepsis by Olvera and Dutra (2016) explores compliance with a standardized order set for physicians and interprofessional education in the perinatal setting for maternal sepsis. The study adjusted the SIRS criteria to consider the physiological changes of pregnancy. This research was conducted at a large hospital in Northern California that performs approximately 5,500 births per year, with 50 physicians and 350 nurses. The study looked at the electronic health record to review compliance with a sepsis bundle before, during, and after implementation of an order set for physicians and interprofessional education. The adjusted SIRS criteria included heart rate of >110bpm and WBCs >20,000 for laboring women and >12,000 for nonlaboring women, temperature was >38.3 Celsius and included mental status changes as an indicator (Olvera & Dutra, 2016). Education was in the form of a two-hour class, poster presentations, one-on-one instruction with relevant literature, and then a posttest was issued. A chi-square test was used to compare pre-intervention and post-intervention bundle compliance, which revealed that in all sepsis cases, except septic shock, the compliance to the bundle was greater post-intervention. The study also revealed some knowledge gaps and fears of over treating for possible sepsis and the consensus was it is better to treat and cause possible pulmonary edema or antibiotic resistance because those are usually treatable, whereas mortality with maternal sepsis is not (Olvera & Dutra, 2016). The study recommends checking lactate levels every six hours in a septic patient until the level is less than 2 mmol/L and broad-spectrum antibiotic be administered within one hour, which is

consistent with the SSC treatment guidelines (Albright et al., 2014; Levy et al., 2018; Faksh & Martin, 2016; Olvera & Dutra, 2016). The study showed that education is essential to understanding and compliance of a sepsis bundle (Arora et al., 2016; Bolger et al., 2017; Olvera & Dutra, 2016; Parfitt et al., 2017).

Current recommendations. A research report by Ford and Scholefield (2014) looked at a 2010 briefing from the United Kingdom Center for Maternal and Child Enquiries that was in response to the increase of maternal sepsis deaths. They explain that there were three main reasons standards of care for sepsis were not being met in cases where there were associated deaths. These three areas are: failure to identify and respond, failures with antibiotic treatment, and failure to manage fluid imbalances (Ford & Scholefield, 2014). Recommendations from this study included raising awareness of the signs and symptoms of sepsis and its seriousness in the medical profession (Ford & Scholefield, 2014). The issues and recommendations found in the following article reflect findings of studies conducted in the US. (Albright et al., 2014; Bonet et al., 2018; Faksh & Martin, 2016; Ford & Scholefield, 2014; Olvera & Dutra, 2016; Tavare & O'Flynn, 2017).

The recommendation of staff training to maintain high-quality maternal care is reinforced by Bolger et al. (2017) and Parfitt et al. (2017). They suggested units have an educational plan, teach the signs and symptoms of suspected maternal sepsis, and have an escalation plan in place (Bolger et al., 2017; Parfitt et al., 2017). They proposed a specific one-day training course that included a simulation of maternal sepsis that included a multidisciplinary team (Bolger et al., 2017; Parfitt et al., 2017). The study looked at compliance to a sepsis bundle before and after staff training and showed a slight increase in compliance after the class. However, the study did recommend the training be cost-effective and hence maybe better off being a four-hour class

instead of a full day (Bolger et al., 2017). Recommendations have been made to include multidisciplinary simulations to increase familiarity with protocols (Arora et al., 2016; Bolger et al., 2017; Parfitt et al., 2017).

The care level of L&D units across the state varies depending on size of hospital, risks of the population, skill level of staff and population of patients. If the pregnant woman needs a higher level of care, it is recommended that she be transferred to the appropriate unit, such as the ICU (Bolger et al., 2017; Ford & Scholefield, 2014; Olvera & Dutra, 2016; Parfitt et al., 2017). This is due in part to interventions such as inotrope support, mechanical ventilation, and multi-organ dysfunction are often outside of the scope of practice for nurses and providers working in L&D units (Ford & Scholefield, 2014; Olvera & Dutra, 2016; Parfitt et al., 2017).

Shields et al. (2016) conducted a study that looked at a Maternal Early Warning Trigger Tool (MEWT) to discover if this tool would help in identifying maternal sepsis early. The primary goal was to assess early and if determined the patient was deteriorating treatment should be initiated rapidly. Signs of deterioration or need for action according to the MEWT include two of the following: temperature >38 Celsius, BP > 160/110, HR > 110, respiratory rate >24, oxygen saturation <93%, fetal HR >160 bpm, altered mental status, or disproportionate pain. These values are not specific to diagnosing maternal sepsis, but for clinical deterioration which can be present in all four of the causes of maternal death, maternal sepsis, cardiopulmonary dysfunction, hypertension/preeclampsia and hemorrhage (Shields et al., 2016). The study found that when the MEWT tool was used, there was a significant improvement in maternal morbidity and mortality (Albright et al., 2017; Bauer et al., 2014; Padilla & Palanisamy, 2017; Sheilds et al., 2016.) The idea that was tested was that if the healthcare professional could be alerted when a patient screened positive to signs of deterioration, further investigation by the physician could

be conducted to figure out the issue and rapid treatment could be initiated (shields et al., 2014). The study found that without the screening tool, many nurses did not notice a problem with their patient and did not notify the physicians (Shields et al., 2014). The MEWT triggers were required to be present for >20 minutes before it could be considered a positive trigger (Albright et al., 2014; Olvera & Dutra, 2016; Padilla & Palanisamy, 2017; Shields et al., 2016).

Issues still under investigation. Several researchers have made suggestions on best practices or recommendations for identifying maternal sepsis, but a formalized guideline has not been developed similar to the SSC recommendations for adult sepsis. The WHO conducted a maternal sepsis study at the end of 2017, referred to as the Global Maternal Sepsis Study (GLOSS) but the results have not yet been fully published (Bonet et al., 2018; WHO, 2018). Once this study is completed, the obstetric world will have a clearer guideline. However, there are limitations on the study findings since it focuses on underdeveloped countries. The study aims to provide a set of actionable criteria for identification of women with possible or confirmed infection and or confirmed sepsis (Bonet et al., 2018; WHO, 2018). Once published, this will be a great resource for health care professionals in obstetrics. Until then, there are many other good quality studies that provide some guidance and recommendations for maternal sepsis signs and symptoms.

Controversies. Researchers and healthcare providers have yet to come up with a proper identification bundle for maternal sepsis as specific as the non-pregnant sepsis identification bundle. Although discrepancies exist with whether the maternal heart rate should be over 100 bpm or 110 bpm, or whether or not fetal tachycardia should be considered, many studies have similar ideas that SIRS criteria must reflect pregnancy physiology (Albright et al., 2014; Arora et al., 2016; Bauer et al., 2014; Bolger et al., 2017; Bonet et al., 2017; Olvera & Dutra, 2016;

Padilla & Palanisamy, 2017; Parfitt et al., 2016; Shields et al., 2016). Therefore, it is imperative to develop protocols for maternal sepsis and educate staff to the importance of early identification.

Theoretical Framework

Implementation science methods can be useful to accelerate quality and safety competence in nursing (Dolansky, Schexayder, Patrician & Sales, 2017). The implementation science model selected for this DNP project is the model for improvement, which was developed by the Associates in Process Improvement and used by the Institute for Healthcare Improvement [IHI] (Langley et al., 2009). This model provides an organized framework to facilitate knowledge from scientific discovery to application in real-life clinical settings (Flannery & Rotondo, 2016).

Historical Development of the Theory

The model for improvement was adopted by the IHI and is often referred to as the IHI's model for improvement (Gillam & Siriwardena, 2013). The model for improvement uses plan-do-study-act (PDSA) cycles to test change. The PDSA cycle is one of the main steps in the model for improvement and is used in many hospital organizations to test change (IHI, 2018). The PDSA cycle was originally developed by Walter Shewhart, afterwards Edwards Deming changed the C (check) of the cycle to S (study) (IHI, 2018). The PDSA cycle concentrates on rapid small-scale changes carried out in a sequence or in parallel to see whether the change is effective before implementing that change on the larger scale (Gillam & Siriwardena, 2013). Associates in Process Improvement developed the model for improvement and the IHI adopted it as their model for change (IHI, 2018). Associates in Process Improvement also develop other

methods and work with organizations to educate and train staff for ongoing improvement (IHI, 2018).

Applicability of Theory to Current Practice

The model for improvement is a simple yet powerful tool for accelerating improvement and is not meant to replace an organization's change model, but to be used in conjunction with any existing models to accelerate improvements (Langley et al., 2017). The model helps to guide the process of change by breaking it down into steps. Some are easy to accomplish, and some take more time (Langley et al., 2017). However, when put together and done in the correct order, the model for improvement can guide change and minimize mistakes or the need for repetition (Langley et al., 2017). The PDSA cycle is only a small part of the model for improvement but is very important and often the most time consuming (Langley et al., 2017). The PDSA cycle is a test of change on a small sample, then before the change is applied to the whole population changes and improvements are made based on the PDSA test (IHI, 2018).

Major Tenets

There are seven major tenets of the model for improvement which include: forming the team, setting aims, establishing measure, selecting changes, testing changes (PDSA), implementing changes and spreading changes (IHI, 2018).

Forming the team. Forming the team is an essential first step for any process improvement and having the right people on the team can impact the success of the project (Langley et al., 2009). The team members will change depending on the needs of the project, but the most successful implementations have a team that includes: a clinical leader, a technical expert, day-to-day leadership members, and a project sponsor (Langley et al., 2009).

Setting aims. Setting aims allows the project to stay on task by having time-specific and measurable intentions (IHI, 2018). The aims need to define the specific population of the project and according to the IOM should be patient-centered and safe (IHI, 2018).

Establishing measures. Establishing measures is an important part of the model for improvement because it informs the team whether the change actually led to improvement, which is the goal of any implementation project (Langley et al., 2009). Measures can include increased knowledge, observable tests, stabilization of biases, and gathering data and should only be timely small tests of change (Langley et al., 2009). There are three types of measurable outcomes and combinations of those outcomes should be used in improvement projects, outcome, process, and balancing measures (Langley et al., 2009).

Selecting changes. Selecting changes involves the development of specific ideas for changes that can lead to improvement (Langley et al., 2009). After these ideas for change are developed, the PDSA cycle is used to do a small test of change and test out the change ideas. If the changes improve practice on a small scale, then the team can be more confident that the changes could be more widely spread (IHI, 2018). The Improvement Guide by Associates in Process Improvement included hundreds of change concepts that can be used both in and out of healthcare (Langley et al., 2009).

Testing changes. Testing changes involves using the PDSA cycle in the real work setting to plan, try, observe the results and act on what is learned (Langley et al., 2009). This is an important step in the process because it informs the team on how effective the changes will be in a real work environment and if any adjustments need to be made before larger implementations (IHI, 2018). The PDSA cycle is also used to minimize resistance upon implementation (Langley et al., 2009). The 'Plan' involves developing a plan for the change that is going to be tested.

This involves the questions of who, what, when and where (Gillam & Siriwardena, 2013). The 'Do' portion is carrying out the test on a small-scale or pilot group. The "Study" is looking at the data before and after the implementation and reflecting on what was learned (Gillam & Siriwardena, 2013). The "Act" is to plan the next steps and modify as needed from the data collected during the study step (Gillam & Siriwardena, 2013).

Implementing changes. Implementing changes is the next step after the test of change PDSA cycle. This step involves learning from the test of change, refining the change, possibly doing more PDSA cycles, and then implementing to the larger population (Langley et al., 2009). Implementation is a permanent change to the way work is done and may affect policies, hiring, education and/or compensation (IHI, 2018).

Spreading change. Spreading change is the final step in the model for improvement and involves distribution of the successful processes into other units or organizations (Langley et al., 2009). The lessons learned during the "implementation" and "test of change" steps can be shared with the greater organization or other similar organizations.

Theory Application to the DNP Project

The model for improvement theory can be readily applied to the proposed practice change. For example, forming the project team is a vital step to the success of this project. The team will include: the clinical leader the OB/gynecological (GYN) service director, technical expert the information technology (IT) registered nurse (RN) specialist, day-to-day leadership, the perinatal director, the chief nursing officer (CNO), and other team members which include L&D and Postpartum supervisors. The aims for the DNP project have been described previously (see project objectives). These objectives are safe, effective, patient-centered, timely, efficient and equitable as described by the Institute of Medicine [IOM] (IHI, 2018). Measures of

improvement for the DNP project will include: increase in nursing knowledge of maternal sepsis, awareness of signs and symptoms of maternal sepsis, improved use of tests to confirm or diagnose maternal sepsis, and rapid treatment of suspected or confirmed cases of maternal sepsis. The knowledge level of nurses will be assessed before and after an educational class on maternal sepsis. Increased awareness of the signs and symptoms of maternal sepsis will be measured by chart reviews of nurses using the sepsis assessment in the EMR. If there is a positive sepsis screening identified in the assessment in the EMR a measurement on follow-up and confirmatory tests, such as lactate will be evaluated. If possible, these measurements will be compared to previous cases. Change concepts to be used in this DNP project will include improving nursing work flow by creating a maternal sepsis assessment in the EMR and managing nursing time by increasing knowledge on medical tests and treatments related to maternal sepsis.

During the plan step of the PDSA cycle, the objectives, research and predictions of the maternal sepsis protocol will be shared with staff. Chart audits will be conducted to see where, if any, fallouts occurred in the early identification of the sepsis diagnosis. The plan to test the change will be made clear to the staff, as this transparency is an important change factor (IHI, 2018). The do step will include carrying out the maternal sepsis assessment on all patients for a one-month period and documenting observations and collecting data. The study step of the cycle will include analyzing the data from the EMR and the assessment steps and analyzing to determine if all areas of the assessment were filled out and if staff knew follow up steps if a patient screens positive. The data will be compared to the predictions and lessons learned will be summarized. The act step will include determining what modifications, if any, need to be made for the next steps. The act step in the PDSA cycle for maternal sepsis will include doing the assessment on all patients once any required changes are made.

Once the maternal sepsis protocol has undergone necessary improvements, the protocol will be implemented unit wide on the L&D and PP units. Every patient who is on the L&D and PP unit will have a maternal sepsis assessment at minimum of once per shift and the protocol will reflect this. Every patient that has a positive screen, will get further testing as indicated by the policy. Treatment of the patient will begin within one hour of documented sepsis. In addition, each new nurse will have the education presented in the educational class upon hire to the unit and their post-test knowledge assessed.

Project Design

The maternal sepsis project is a quality improvement (QI) project with a nonexperimental design. The goal of the project is to implement a protocol to screen patients for maternal sepsis and if they screen positive, to treat them within one hour as described in the literature as best practice (Levy et al., 2018). Educating the staff on the signs and symptoms of maternal sepsis and how to use the screening assessment is essential to the success of the project. One of the objectives of the project is to increase nurses' knowledge level in relation to maternal sepsis. Non-experimental designs describe existing phenomena without manipulation of individual variables (Radhakrishnan, 2013). Although non-experimental designs are considered weak in comparison to other designs, they are often used for QI methods because they involve researching and analyzing literature (Radhakrishnan, 2013). The method to implement this QI project will be the IHI model for improvement.

The literature review of maternal sepsis has provided important assessment information that will be used to develop an assessment field in the EMR, Meditech, which is used by the site hospital. The nurse will be required to complete this assessment once per shift or more frequently if needed based on concern or status change of the patient. Nurses and physicians will

then be educated on the assessment as well as the signs and symptoms of maternal sepsis, the appropriate one-hour treatment bundle, and the protocol for notification of the healthcare team. Nurses' knowledge of maternal sepsis will be evaluated before and after the educational intervention.

Population of Interest, Stakeholders, and Practice Setting

Population of interest. The direct population of interest is the staff nurses working in L&D and PP. Currently, the L&D unit has 52 RNs and the PP unit has 60. All will be required to attend; unit secretaries and technicians will not be required to attend as they will not be assessing the patients. The physicians will not be required to attend the education class, but education on the new order set and policy will be provided to them at their monthly meetings.

Stakeholders. The stakeholders include the L&D and PP nurses, the resident physicians, currently 24 and the attending physicians who have privileges in OB, currently 16. In addition, the staff is also considered stakeholders in the project as their acceptance of the process is crucial to success. Other stakeholders include the women's and children's director of the site hospital and the information technology (IT) department. Since the author of this project has worked at the hospital for 12 years, a rapport with the director and the IT department already exists and allows changes and conversations to happen in a timely manner.

Setting. The setting of the project will be the L&D and PP units at the site hospital. The site hospital is a county hospital in California and has 171 beds. The site hospital performs approximately 2500 deliveries per year. The L&D unit consists of eight labor beds, two triage beds, two operating rooms and two recovery beds. Permission to carry out the project has been granted by the site hospital, education department, perinatal director and chief of OB. The

project will fill a gap in providing excellent and safe patient care. A contract between the hospital and university has been signed in order to allow for this QI project.

Recruitment Methods

Staff nurses. The maternal sepsis project is a QI project and will involve all nurses on the perinatal units. Mandatory training will be required for all registered nurses (RNs). Every nurse who is employed will be included, except those who will be on vacation for the training or those on leave from work. Scheduling will be done by the unit nurse supervisors to ensure every nurse is scheduled to attend a class. Confidentiality of the nurses completing the knowledge test will be maintained by anonymity. There will be no names collected, only answers.

Chart audits. A random sample size of 25 charts for the month post implementation will be audited to ensure that nurses are completing the sepsis screening assessment on all patients. Of the patients who screen positive, 100% of those charts will be reviewed to ensure that the proper protocol and treatment was provided. After the first month of audits, if the new protocol is being followed then a random sample size of 10 patients who positively screened for sepsis will be audited. The chart audits will help to determine if changes to the assessment or process need to be made. The audits will be kept in an excel spreadsheet, all patient identification information will be omitted. Names will be replaced with numbers and the file will be kept on a locked drive on a personal work computer station.

Tools/Instruments

Nursing Knowledge Levels and Training

A PowerPoint presentation will be used for training nurses on the signs and symptoms of maternal sepsis, treatment protocols, and the Meditech assessment. Included in this will be an assessment of the RN knowledge levels regarding early identification and management of

maternal sepsis. The setting of the education will occur in the meeting room adjacent to L&D. The knowledge assessment test will be anonymous and be completed using paper and pencil. The knowledge assessment will be given the day of the educational class as a pre and posttest.

Chart Audits

Sepsis screening. The maternal sepsis project will use the hospital's Meditech system for tracking sepsis. If the RN determines that the patient has screened positive for sepsis per the Meditech assessment, the physician will be requested for a bedside evaluation. This will also be audited to ensure the evaluation happens within the goal time of 15 minutes. The perinatal units have 24/7 physicians on duty and so an evaluation within 15 minutes is achievable. A report will be created by IT to allow this sepsis assessment to be audited to ensure nurse compliance with completing the assessment. Meditech will generate a report of all patients that had the sepsis screening tool completed and a random number of charts will be reviewed to determine the following:

1. Was the assessment (sepsis screening) completed on admission? Y/N
2. Was the assessment completed at least once a shift Y/N
3. If a patient screened positive for sepsis, was the physician notified within fifteen minutes? Y/N

Sepsis bundle completion. A secondary auditing tool will be used to measure compliance with the one-hour treatment bundle for those women who screen positive for sepsis. The auditing tool will determine the following:

1. Was a lactate level drawn? Y/N
2. Were the blood cultures drawn? Y/N
3. Was a broad-spectrum antibiotic started within an hour? Y/N

4. If indicated, was fluid resuscitation started? Y/N
5. If indicated, was the patient transferred to the ICU? Y/N

The IT department will be involved in the creation of these reports and audit tools.

Data Collection Procedures

Nursing Knowledge Levels

Data from the pre and post education knowledge levels will be compared to show if nurses' knowledge increased from the educational class. The knowledge test will consist of ten multiple-choice questions. The sample size will be the approximately 100 participants in the education, which the goal is 100% of nurses in labor and delivery and postpartum. The response rate goal is also 100% assuming every participant will participate in the paper knowledge test during the class.

Chart Audits

Currently, no assessment tool for maternal sepsis exists in the EMR for patients in OB, therefore a retrospective audit cannot be conducted. Four weeks after implementation of the sepsis assessment, 25 random charts will be reviewed to determine if there has been improvement in assessment and treatment of maternal sepsis. IT will generate a report that will identify any patient with the diagnosis code or discharge code of infection or sepsis related to pregnancy. These charts will all be examined to ensure proper screening and treatment per the new policy.

Intervention/Project Timeline

Approvals for the project have already been obtained as described above and much of the project planning has been completed. Implementation of the maternal sepsis project will occur over five weeks with the following proposed timeline:

Phase One-Pre-Implementation (Week 1 and 2)

During phase one, which will last two weeks, the project lead will meet with stakeholders (supervising nurses, director, chief of OB, IT) and run through the educational program so that they can provide feedback prior to course delivery. Staff will be prescheduled and assigned to a specific maternal sepsis class. The policy written by the project lead will be submitted to the OB safety improvement committee (SIC) and either approved or changes will be made as suggested for resubmission.

Phase Two Training (Weeks 3-5)

Phase two will be approximately three weeks long and the main goal will be providing educational classes for the staff RNs. Each RN will attend a single two-hour educational class and learn about the new maternal sepsis policy. During this class, a pre-intervention knowledge test will be administered to the nurses to compare with a posttest completed directly after the class, the same posttest will be assigned ten weeks after the class and the results compared. The RNs will be oriented to the policy and the treatment order set and screen shots will be viewed during the educational class. Due to the number of RNs requiring education, the same class will be held multiple times over the three weeks in order to allow everyone to attend one class and to ensure smaller class sizes for optimal engagement. The classes will be spread over three weeks to allow for different schedules and vacations.

Phase Three Go Live (Week 6)

During phase three, the maternal sepsis assessment in Meditech will go-live and nurses will start charting on the assessment. Along with the Meditech assessment go-live will be the maternal sepsis order set, which will be similar to the one already used by the site hospital for the adult patient, with the omission of some drugs considered not safe during pregnancy. The go-

live will all occur on a single date determined by the project lead and IT. During this phase, which will be three weeks long, the project lead will make daily rounds assisting nurses with the assessment as needed.

Phase Four Evaluation (Week 6-8)

Data collection will occur during this phase and the chart audit spreadsheets will be completed. Two weeks of data will be collected to assess completion of maternal sepsis assessment and appropriate treatment for the patients who screen positive.

Ethics and Human Subjects Protection

The maternal sepsis project is a QI project and does not involve direct patient care or contact. Since this is a QI initiative, it received Institutional Review Board (IRB) exempt status from the site hospital. No consents will need to be obtained since the RNs need to be trained on the new policy. Staff sign-in sheets will be collected during the educational class for record of completion, but no other confidential information will be obtained. Each nurse will be given two separate pieces of different colored papers during the class to differentiate the pre and posttests, in addition the posttest will be given again in week 10 to assess if nurses retained the knowledge. Since the maternal sepsis education will be a mandatory class, the RNs will be paid their hourly rate to attend the class and this has been approved by the director. No additional compensation or incentives will be provided to the RNs. There are no risks associated with attending the education class.

During the chart review process, no patient identifying information will be recorded. Patient names will be replaced with numbers and the chart audits will be kept in a private drive on the project lead's work computer that is password protected and secured in a locked office.

Plan for Analysis/Evaluation

Two different aspects in the project will be analyzed, staff knowledge levels and EMR assessment compliance. A paired t-test will be utilized to analyze if there was an increase in nurse's knowledge of maternal sepsis and the protocol pre-implementation and post. Ideally, the test will show a significant increase in knowledge scores after implementation of the sepsis policy and educational class.

Nurses' compliance to the new policy will also be evaluated. The project lead will be performing chart audits to ensure that nurses are consistently completing the required assessment and if patients screen positive, the appropriate next steps as outlined in the policy. The data from these audits will be kept in an excel spreadsheet on the project leads locked drive in the work computer. Data results will be shared with staff to encourage 95% compliance.

Significance/Implications for Nursing

The aim of the project was to develop and implement a new protocol to assess for and treat maternal sepsis. Maternal sepsis is included in the top four reasons why pregnant or postpartum women die (Olvera & Dutra, 2016). Prior to this project, there was no formal assessment protocol or screening for sepsis in the pregnant population at the site hospital. All adult patients who come in through the ER are screened for sepsis; therefore, it needed to be the same for all the pregnant women. By implementing a protocol, there is now standardization of the assessment and screening for maternal sepsis. Standardization of care helps to reduce errors and omission (Clark et al., 2013). Sepsis in pregnancy or postpartum is often masked by the symptoms and physiological changes of pregnancy. Nurses will utilize the protocol to screen all patients every shift; and possible or confirmed cases can be identified and treated without delay in an attempt to decrease associated morbidity and mortality (Bonet et al., 2018; Ford &

Scholefield, 2014; Padilla & Palanisamy, 2017). By increasing nurses' knowledge of maternal sepsis and having a built-in assessment tool in the EMR, patient's lives can potentially be saved.

Analysis of Results

Data analysis is an important part of any QI project, the goal is to show improvements in patient outcomes and/or nursing knowledge. Data analysis is what takes the information from the project and turns it into meaningful information that can be interpreted (Moran, Burson & Conrad, 2017). For the maternal sepsis project, the goal was to increase nurses' knowledge on maternal sepsis and to implement an assessment screening tool and treatment protocol. Early identification and treatment of maternal sepsis is what is going to save the patient's life (Dutra & Olvera, 2016). An identical pre and posttest with maternal sepsis knowledge questions was given to participants during the training session. This intent was to evaluate immediate learning during the educational class.

A total of 99 L&D and PP nurses participated in the education which was 88% of all nursing staff. A few staff members called in sick for their scheduled training or were out on an approved leave which brought the goal of 100% down. One make-up class will be offered after the scheduled unit skills day next month. Six residents and attending physicians joined the training, but this was not mandatory for them. The knowledge test showed an increase in overall knowledge of the ten-question quiz by 33%, with the average correct percentage in the pretest to be 51.2% and the posttest to be 84.5%.

Knowledge Levels

Figure one below demonstrates the knowledge level improvement in maternal sepsis signs and symptoms and proper protocol during the educational class. The individual questions are then broken down into pre and posttest scores. Figure two shows the improvements between

the pre and posttest answers broken down into the ten individual questions. Being able to see which questions were still incorrect allows for extra education in those identified area (see Appendix C for specific questions).

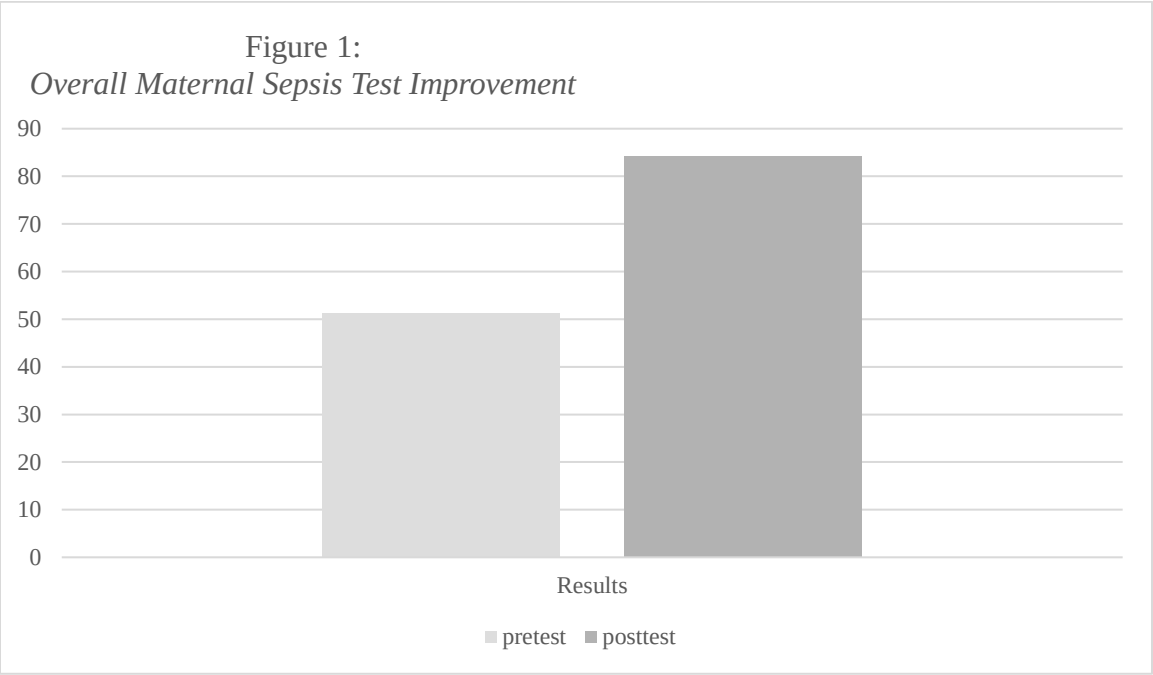

Figure 1: Overall Maternal Sepsis Test Improvement

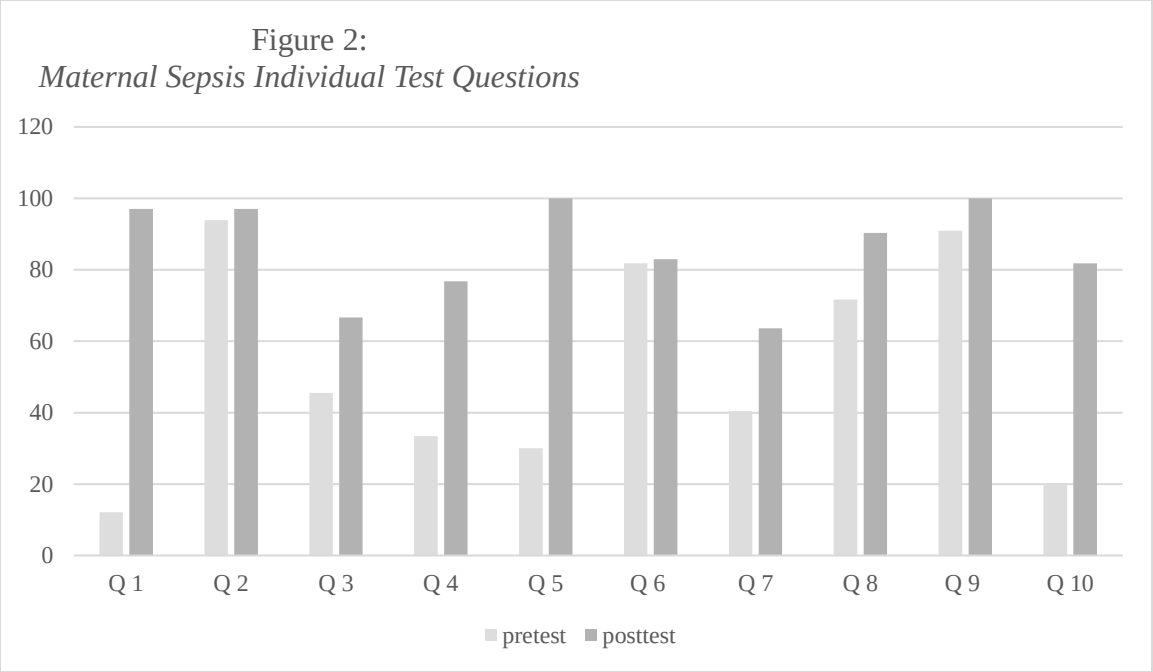

Figure 2: Maternal Sepsis Individual Test Questions

A paired sample T-test was used to determine the statistical significance of the knowledge levels. This statistical test was chosen because it is used to collect data from the same group of individuals on two separate occasions (Pallant, 2013).

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest	51.2121	99	13.49775	1.35657
	Posttest	84.5455	99	11.09079	1.11467

Figure 3: T-Test Results

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pretest & Posttest	99	-.119	.241

Figure 4: Correlations

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest-Posttest	-33.33333	18.46121	1.85542	-37.01536	-29.65131	-17.965	98	.000

Figure 5: Standard Deviations

Figure three through five shown the breakdown of the T-test for the pre and posttest answers. The results show there is a statistically significant increase between the pretest (M= 51.21, SD = 13.50) and posttest (M= 84.55, SD = 11.09) scores (t = -19.97, p = 0.000). The mean increase in scores was 33.33 with a 95% confidence interval stretching from -37 to -29.7. These scores indicate that there was a significant increase from time one (pretest) to time two (posttest) in knowledge or understanding of maternal sepsis concepts that were taught (Pallant, 2016). Statistics are difficult because they can be influenced by multiple factors or nothing at all, but this data is helpful in that it shows a relationship between the pre and posttests (Connelly, 2014). The same test will be administered one month after the classes to assess if the knowledge was retained.

Maternal Sepsis Assessment Compliance Audits

Maternal sepsis assessment compliance audits were conducted to monitor if all patients had the maternal sepsis assessment completed once per shift as per the new policy. Each shift at the site hospital is twelve hours, so there is one day shift and one night shift, meaning the patient should have had two assessments per day or 24 hour period. After two weeks of implementation there were 281 assessments completed, which equated to the assessment being performed 80% of the time. There were 353 opportunities the assessment should have been completed during the two weeks implementation process. When inquiring as to why the assessment was not

completed, the results included: the nurse forgot the assessment was live, the nurses did not have time to complete the assessment, and the nurse did not believe the patient met criteria hence did not fill out the assessment. The goal was to have the assessment performed 95% of the time; hence there is still progress needed to meet this goal. Strategies to improve compliance and meet this goal include: reminding staff about the assessment, individual coaching and continued reporting of compliance (Connelly, 2014).

Before the project, a maternal sepsis screening documented in the EMP did not exist. Therefore, a comparison is a simple percentage due to the fact that the before percentage is zero. Hence, the 80% completion rate is an improvement as shown in Figure 3 and increasing this percentage to the 95% goal will be encouraged.

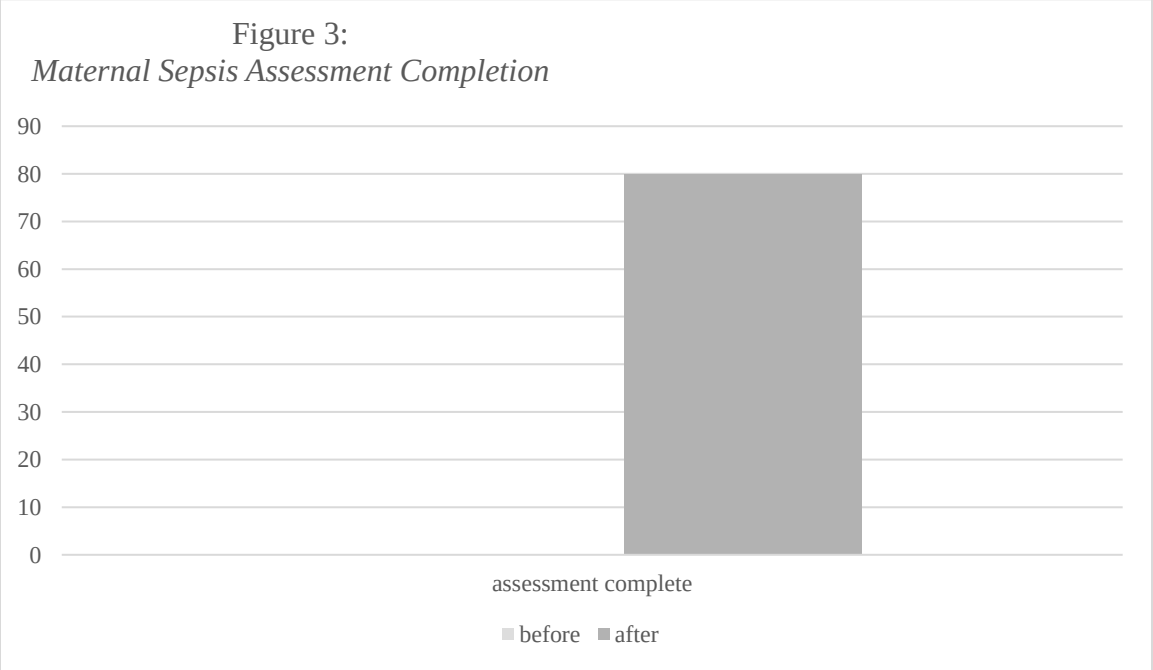

Figure 3: Maternal Sepsis Assessment Completion

Positive Sepsis Screen Intervention Audits

The sepsis screen intervention was audited to ensure patients who had a positive sepsis screen had the appropriate interventions performed per protocol. This audit consisted of five different categories: bedside evaluation, lactate drawn, blood cultures drawn, fluid bolus started, and transfer to ICU if indicated. Of the 281 assessments that were completed there were five positive sepsis screens obtained. These five charts were reviewed for compliance with the protocol as shown in Table 1.

Table 1:

Maternal Sepsis Protocol Compliance

Positive Sepsis Screen Patient	Lactate Drawn Y/N	Blood Cultures Y/N	Antibiotics within 1 hour Y/N	Fluids Y/N	Transfer to ICU Y/N
1	Y	Y	Y	Y	N
2	Y	Y	Y	Y	N
3	Y	Y	N	Y	N
4	Y	Y	Y	N	N
5	Y	Y	Y	Y	N

Table 1: Maternal Sepsis Protocol Compliance

As shown in Table 1, patient three's antibiotics were not started until 73 minutes after sepsis screen positive and after investigation the reason was because the nurse was waiting for the lab to draw the blood cultures, which were done at 58 minutes. Education on not delaying antibiotics was reinforced and the nurses stated understanding. Patient four was not treated with a fluid resuscitation per guidelines due to her condition and being on fluid restrictions, this was discussed with the physician and deemed appropriate by the attending physician at the site hospital.

Timely Evaluation Audits

The timely evaluation audits looked at the patients who had a positive sepsis screen and the time of the bedside evaluation by the physician, with the goal being within 15 minutes. Of the five positive sepsis screens, 100% of these patients were seen by their provider within 15 minutes, the average time being eight minutes. The time was a simple calculation of all the time in minutes per the nurses charting and divided by five.

Prior to this maternal sepsis assessment and protocol there was no formal way that patients were screened or treated, it was up to the nurse or provider to recognize signs and symptoms of sepsis and then treat timely and appropriately. Due to this fact, before and after data cannot be compiled reliably since there is no way of abstracting before data.

Discussion and Significance

The data from the QI project showed that nurses have an increase in knowledge level in regard to maternal sepsis, nurses are using the maternal sepsis assessment, and patients with a positive sepsis assessment are being treated and evaluated in a timely manner. Before the project there was no screening criteria or treatment bundle for maternal patients at the site hospital. A screening tool and treatment bundle did exist for adult patients on other units or in the ER, but not pregnant and postpartum patients. Using a standardized workflow and multidisciplinary team collaboration, safety measures are maximized, and lives can potentially be saved (Tussey & Olson, 2018). A standardized approach towards a maternal sepsis assessment helped to improve outcomes by reducing errors (Tussey & Olson, 2018). Having the SSC one-hour bundle requirements built into the sepsis order set allowed all five of the identified patients to receive timely treatment of sepsis and potentially avoid morbidity as none of them needed to be transferred to the ICU.

There were four project objectives of the maternal sepsis project which include:

1. Develop and implement a maternal sepsis protocol based on best practice in the practice site L&D and postpartum (PP) unit. This objective was met through the creation of a maternal sepsis guideline that was approved by the physicians, administration and the medical executive committee. The guidelines are based on EBP developed by the SSC and also through collaboration with other facilities who have imlemented maternal sepsis policies. The policy for the hospital site is in Appendix G.
2. Implement an assessment and alert system in the eletronic medical record (EMR) to identify maternal sepsis or infection and alert staff. This objective was met through the creation of the maternal sepsis assessment in Meditech. The assessment uses the maternal SIRS criteria to alert of possible sepsis and start timely evaluation and treatment (Levy et al., 2018). Before the project, a maternal sepsis screening documented in the EMR did not exist. Therefore, a comparison is a simple percentage due to the fact that the before percentage is zero. Hence, the 80% completion rate is an improvement as shown in Figure 3. With some additional time and education, the goal will be to improve this number in the coming months.
3. Improve knowledge levels of L&D and PP unit staff on early identification and management of early maternal sepsis by hosting an educational class for staff and providers on maternal sepsis and the protocol, evaluating beginning and ending knowledge of participants. The pre and posttests showed an improvement in nurses' knowledge in regards to maternal sepsis, therefore, this objective was met. The hospital site had no education on sepsis or identification of signs and symptoms, which are critical in decreasing morbidity and mortality (Parfitt et al., 2017). Figure three through five

shown the breakdown of the T-Test for the pre and posttest answers. The results show there is a statistically significant increase between the pretest (M= 51.21, SD = 13.50) and posttest (M= 84.55, SD = 11.09) scores (t = -19.97, p = 0.000). The mean increase in scores was 33.33 with a 95% confidence interval stretching from -37 to -29.7. These scores indicate that there was a significant increase from time one (pretest) to time two (posttest) in knowledge or understanding of maternal sepsis concepts that were taught (Pallant, 2016).

4. Improve early management and treatment of maternal sepsis cases to meet one hour bundle times. In the five positive sepsis cases since implementation of the policy the one hour bundle requirements by the SSC were met. However, it is impossible to know if the maternal sepsis assessment is responsible for earlier identification and treatment because there was no way of tracking sepsis prior to this project. Of the five positive sepsis screens identified thus far, 100% of these patients were seen by their provider within 15 minutes (see Table 1). In four out of the five cases antibiotics were started within an hour, which is considered timely treatment (Table 1). During the first two weeks of implementation, the maternal sepsis assessment identified five patients who had a sepsis screen positive and were able to be treated within one hour to improve outcomes (Leyva et al., 2018). Without this assessment the care may have been delayed and the patients' conditions could have potentially worsened.

The sepsis continuum progresses quickly from sepsis to septic shock if not identified; and pregnant patients often mask the initial signs, making a-standardized assessment even more crucial (Shields et al., 2016). The four objectives of the project were met and continue to be

improved upon as discussed. Multidisciplinary approaches to care allow for better adherence and sustainability in policies (Sockolow, Rogers, Bowles, Hand & George, 2014).

The site hospital is one of few hospitals in California that has a maternal sepsis protocol where all patients are screened (California Maternal Quality Care Collaborative [CMQCC], 2015). The research regarding the maternal sepsis protocol implementation was limited in the literature, although there was much information on how to treat sepsis, but how to recognize maternal sepsis was lacking. The literature did support educating nurses on the signs and symptoms and pathophysiology of maternal sepsis in order to better outcomes, which was included in this project (Bolger et al., 2017). The literature supported screening all OB patients for maternal sepsis, which was also incorporated in the project (Olvera & Dutra, 2016). The evidence for treatment of maternal sepsis is the same as all adult sepsis, as researched by the SSC and the maternal sepsis project incorporated this evidence into the order set for all positive screened patients (Levy et al., 2018).

The project question: does having a maternal sepsis protocol help with early identification and treatment of maternal sepsis on the perinatal units, can now be answered. The answer to the question is yes, having the maternal sepsis protocol did help the perinatal units with early identification and treatment of maternal sepsis. This was evident by the increase in use of a screening assessment,when prior to implementation patients were not being screened. The assessment helped to identify patients who were exibiting signs and symptoms of sepsis so that further evaluation and treatement can be delivered quickly.

The project data is significant to nursing because not only did the nurses' knowledge of sepsis improve, but so did the recognition of signs and symptoms which will lead to improved patient outcomes.

Limitations

Along with the successes of the maternal sepsis project, there were also limitations. Related to project design, the go-live for the implementation was later than expected because of IT programming and scheduling at the hospital site. In addition, physician scheduling did not allow for them to attend an educational class, which left some of the physicians unsure of what the new process was. Flyers were posted and emails were sent out to physicians, but some still stated they had no knowledge of the new policy. Through some individual coaching and case reviews this was improved in the first two weeks. The laboratory (lab) personnel did not attend a class, and some were not informed by the lab director of the new protocol. Phlebotomy plays a key role in the execution of the maternal sepsis protocol by drawing the lactate and blood cultures in a timely manner so that antibiotics can be started within one hour. In relation to data recruitment and collection methods, the delay in go-live only allowed for analysis of two weeks' worth of initial implementation data. When rolling out new processes there is a need for additional support and time to resolve any issues. The project lead worked with staff on multiple shifts to answer questions regarding the new assessment, but completion numbers may have been less than desired due to confusion with the assessment. In relation to data analysis, the only limitation was not having any initial data for the maternal sepsis assessment and treatment compliance since one did not exist before this project. A true improvement cannot be evaluated as there is no before data to pull from, it can only be assumed that timely treatment and recognition was not as timely.

Dissemination

Dissemination is an important concept because it facilitates the spreading of key information allowing for other organizations to adopt the ideas and improve patient care (Moran

et al., 2017). Communication and support for staff helps to make changes more accepted and sustainable (Sockolow et al., 2014). Even if the maternal sepsis policy is not adopted by other hospitals, the information can be used by other nurses and educators to gain insight into maternal sepsis and hopefully improve patient outcomes. When the project lead asked neighboring facilities about a maternal sepsis policy in the beginning phases, no other hospital within 100 miles had a policy, but all asked to have the information and research to be shared with them after implementation. A poster presentation will be submitted to AWHONN for the national conference in 2020. The conference is attended by over 10,000 perinatal nurses annually and the information has the ability to spread and be adopted by many other facilities. The insurance group at the site hospital, BETA healthcare group, works with the hospital to try and promote patient safety and reduce risk. The maternal sepsis project developed was shared with BETA healthcare insurance group and the project lead was asked to submit and present a poster at the BETA annual member symposium in September. The project will also be submitted to the DNP repository at www.doctorsofnursingpractice.org and shared with course faculty and fellow students at Touro University Nevada. The data analysis will be shared with the stakeholders at the site hospital at a presentation by the project lead in August for the annual poster education day.

The DNP project has minimal costs and resources required to sustain the project and so far, the outcomes have been positive. A project is sustainable if the outcomes are positive, the costs are minimal and the resources required are low (Moran et al., 2017). Patients are being recognized as possible sepsis early and treatment is following the one-hour bundle guidelines. Improvements to the policy are anticipated as more data on maternal sepsis is discovered. The CMQCC is developing a sepsis bundle guideline for California to be published by the end of

2019, which should prompt many more California hospitals to develop a protocol for maternal sepsis screening (CMQCC, 2015). It will be interesting to compare the current protocol at the site hospital to the bundle developed by the CMQCC. The project lead will continue to assess the EBP research on maternal sepsis and make the necessary updates.

Conclusion

Maternal mortality and morbidity continues to rise in the US despite best efforts of health care professionals (CMQCC, 2015). Maternal sepsis is among the top causes of maternal morbidity and mortality worldwide (Olvera & Dutra, 2016). This project focused on the development of a policy that would screen all maternal patients for the signs and symptoms of sepsis and if there was a positive screen a timely treatment regimen followed. An assessment in the EMR helped nurses to recognize if their patient may have sepsis and to notify physicians and treat the patient within the recommended one-hour of identification. Early identification and treatment of maternal sepsis is what will save lives and the maternal sepsis policy developed and implemented had that as the focus. Improvements and evaluation will continue and the information gathered will be shared with other healthcare professionals to try and eliminate maternal sepsis as a top four killer of pregnant and postpartum women in the US.

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Appendix A:

Maternal Sepsis PowerPoint

PRE-TEST – blue paper

Question 1

- Maternal sepsis can lead to maternal mortality. Where does sepsis rank in maternal mortality is in the US?
- 1. 2nd
- 2. 3rd
- 3. 4th
- 4. 5th

Question 2

- How can health professionals decrease the mortality rate associated with maternal sepsis?
- 1. Early identification and treatment
- 2. Selecting appropriate antibiotic treatment
- 3. Early fluid resuscitation
- 4. Being aware of the disease process

Question 3

- A positive Systemic Inflammatory Response Syndrome (SIRS) indicates what?
- 1. Infection
- 2. Severe sepsis
- 3. Septic Shock
- 4. Moderate sepsis

Question 4

- Which SIRS criteria differs in the obstetric population?
- 1. HR, BP, Temp.
- 2. HR, RR, WBCs
- 3. HR, BP, WBCs
- 4. HR, RR, Temp.

Question 5

- When should antibiotics be started on a sepsis patient?
- 1. Within one hour
- 2. Within 2 hours
- 3. Within 3 hours
- 4. Immediately

Question 6

- What is the first priority for a patient who has a new diagnosis of severe sepsis?
- 1. Prepare for transfer
- 2. Monitor Urine output
- 3. assess for adequate IV access to administer fluids & antibiotics
- 4. review all lab results and complete documentation

Question 7

- Time zero is when the following are present:
- 1. suspected/conformed infection
- 2. organ dysfunction
- 3. two or more SIRS criteria
- 4. All of the above

Question 8

- 30 YOF 2d PP with first baby s/p normal vaginal delivery presents with fever, chills & urinary frequency. Current VS: 101.2, 124, 24, 112/58, 98% RA. How would you screen the patient?
- 1. positive
- 2. negative

Question 9

- Patients in obstetric services should be assessed for sepsis?
- 1. once a day
- 2. once per stay
- 3. once per shift
- 4. when the physician asks

Question 10

- When should a patient be transferred to ICU (per policy)?
- 1. When sepsis is identified
- 2. When severe sepsis is identified
- 3. When septic shock is identified
- 4. After she delivers her baby

Maternal Sepsis

Jennifer Niduaza, MSN, RNC-OB

Learning Objectives

- Describe Systemic Inflammatory Response Syndrome (SIRS), sepsis, severe sepsis & septic shock.
- Identify criteria for early recognition & treatment for obstetric patients with severe sepsis & septic shock.
- Identify actions required by the RN to facilitate appropriate care for obstetric patients with severe sepsis & septic shock.
- Describe the variation in SIRS criteria for the obstetric vs non-obstetric population.
- Describe the treatment protocol for sepsis.

15

Just Like Heart Attack and Stroke:

16

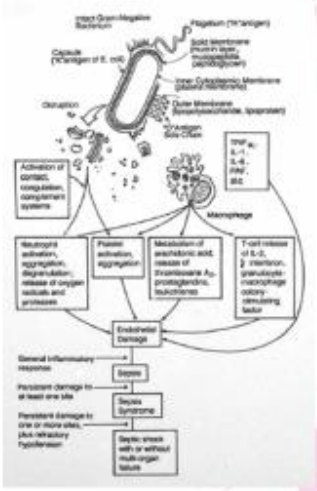
Schematic of Sepsis

"… this **schematic** illustration somewhat **oversimplifies** the pathophysiologic process…"

"… provides a **framework** for understanding a **complex** chain of events."

"The pathways are not distinct, and the **effects** of any one mediator **may vary** with physiologic conditions."

"If the body cannot restore homeostasis… the general **inflammatory response** will produce clinical evidence of **sepsis**."



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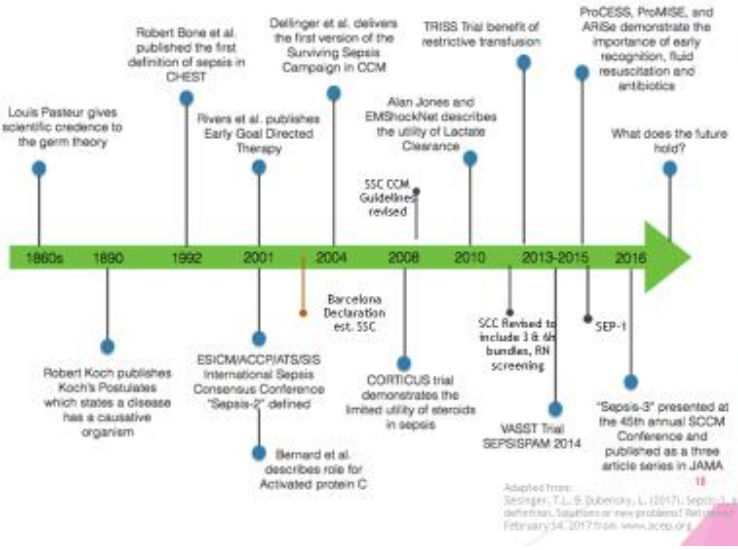
Sepsis is Not a New Concept



Adapted from:

15

Obstetric Sepsis

Is rare & accounts for less than 1% of all sepsis patients, BUT

- **Maternal sepsis is:**
  - *One of the top four causes of maternal mortality*
  - Associated with:
    - Increased rates of fetal infection
    - Preterm labor/delivery
- **Obstetric patients:**
  - Are more vulnerable to infection/serious complications
  - Appear deceptively well before rapidly decompensating
  - Tend to be younger & healthier, thus have more favorable outcomes when sepsis is recognized & treated early
  - Experience normal physiologic changes that may mimic early symptoms of sepsis
  - Perinatal staff must be trained on early recognition and management

20

Risk Factors During Pregnancy

Prenatal Risk Factors	Intrapartum Risk Factors	Postpartum Risk Factors
• Received antibiotic therapy two weeks prior to admission • Multiple gestation • Pneumococcal infection	• Protracted active labor, especially in the nullipara • Prolonged rupture of the membranes • > 5 vaginal examinations • Perineal manipulation during second stage • Use of instrumentation at the time of delivery	• Operative delivery • Cesarean delivery • Retained placental fragments • Cracked nipples

"The single most critical factor for sepsis is an unscheduled cesarean birth."

- Carol Burke, MSN, RNC, APN

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Causes of Sepsis in Pregnancy

- Acute pyelonephritis
- Retained products of conception
- Neglected chorioamnionitis/endomyometritis
- Pneumonia
- Unrecognized/inadequately treated necrotizing faciitis from
  - Abdominal incisions
  - Episiotomies
  - Perineal lacerations
- Non-obstetric causes such as:
  - Acute/ruptured appendicitis
  - Bowel infarction
  - Acute cholecystitis
  - Necrotizing pancreatitis

22

So, What IS Sepsis?

23

Sepsis Progression: SEP-1 Definitions*

SIRS
- Systemic Inflammatory Response Syndrome (SIRS). A group of clinical criteria that indicate a systemic reaction to an insult. Not specific to infection.

Sepsis
- Two or more SIRS ***with a known or suspected infection***.

Severe Sepsis
- Sepsis with acute sepsis-induced hypoperfusion or organ dysfunction.

Septic Shock
- Severe sepsis with sepsis-induced hypotension *persisting despite adequate fluid resuscitation & requiring vasopressors.*

24

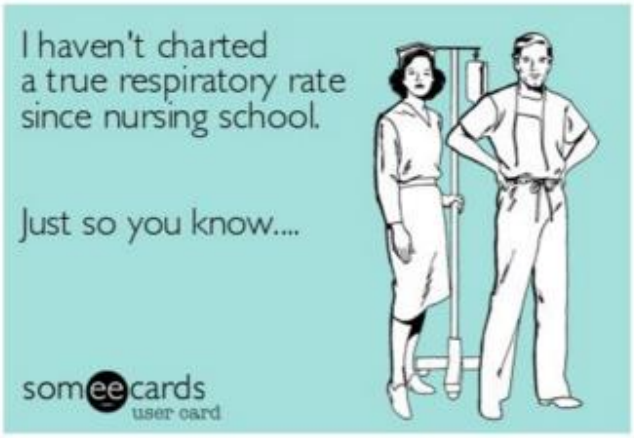
** Recent publications have recommended new definitions for sepsis, severe sepsis & septic shock. CMS has not updated their guidelines to reflect the new definitions. Therefore, ECH will continue to use the CMS definitions until CMS guidelines are updated accordingly.*

Identification Using SIRS

Systemic Inflammatory Response Syndrome

GENERAL ADULT Population *Patients older than 18 years of age or weighing more than 36 Kg (80 lbs.)*	OBSTETRIC Population *Pregnant females > 14wks gestation or < 4 weeks postpartum*
• Hyperthermia > 38.3˚C (100.9˚F) • Hypothermia < 36˚ C (96.8˚F) • Tachycardia > 90 bpm • Tachypnea > 20 breaths/minute • WBC count > 12,000µL or < 4,000µL • Normal WBC with >10% bands	• Hyperthermia > 38.0˚C (100.4˚F) • Hypothermia < 36˚ C (96.8˚F) • Tachycardia > 110 bpm • Tachypnea > 24 breaths/minute • WBC count > 15,000µL or < 4,000µL • Normal WBC with > 10% bands • Fetal heart rate baseline > 160 bpm (≥ 23 weeks)

25

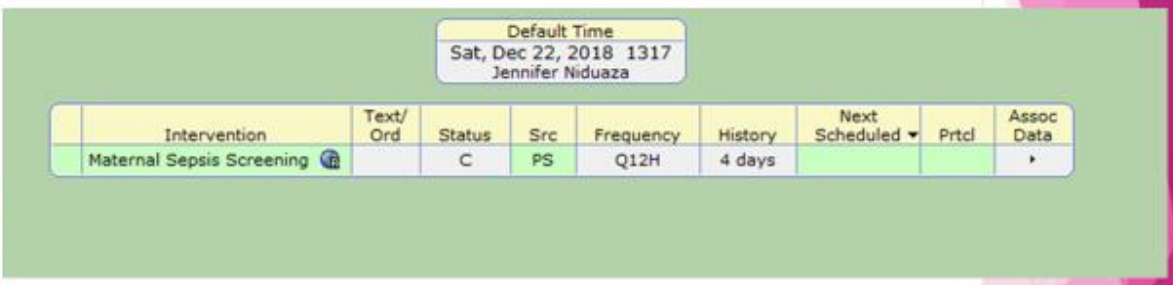


26

Natividad Sepsis Inititative

- GOAL: Reduce morbidity and mortality from severe sepsis and septic shock
- Strategies:
  - Early recognition and treatment
  - Prevent mother and baby harm
  - Use of a standardized workflow

Maternal Sepsis Screening Tool



Maternal Sepsis Screening Tool

Evidence Link

Level 1 - Infection	
S&S of Infection Present or Pt. has Documented Infection	○ Suspected New Infection ○ Documented Infection ○ None Such as: *Recent Invasive Procedure or Surgery *Fever/Chills *Cough/Shortness of Breath *Urinary Tract Infection *Pyelonephritis *Chorioamnionitis
Level 2 - SIRS	
SIRS Criteria Present	☐ Pulse > 110 bpm ☐ Temp > 38.3 C ☐ RR > 24 rpm ☐ Temp < 36 C ☐ WBC < 4,000 ☐ WBC > 15,000 ☐ Bands > 10% ☐ None
Level 3 - Organ Dysfunction	
Organ Dysfunction Criteria Present	☐ Altered Mental Status ☐ Creatinine > 2 mg/dl ☐ SBP < 90 or MAP < 65 ☐ Platelets < 100,000 /uL ☐ Urine Outp <0.5 ml/kg/hr ☐ Lactate > 2 mmol/L ☐ Acute Respiratory Failure ☐ Total Bilirubin > 2 mg/dl ☐ Blood Glucose>140 (no DM) ☐ INR>1.5 or aPTT>60s ☐ SBP drop > 40 baseline ☐ None
Response	
Sepsis Screen	
Sepsis Action Taken	○ Provider Notified ○ Prov Previously Notified ○ No Action Required
Name of Provider Notified	

1/22/19

Maternal Sepsis Pathway

New or suspected infection + **2 or more SIRS criteria**
Temp > 38C or <36C
Maternal HR >110 bpm
RR > 24
WBC > 15,000, <4,000 or >10% immature neutrophils
Altered mental status
Glucose >140 no DM/GDM
= SEPSIS
Bedside evaluation

SEPSIS + **1 or more features of acute organ dysfunction:**
Lactate > 2mmol/L
SBP < 90 or MAP < 65 and HR >100
SBP decrease <40 from baseline
Bilirubin >2mg/dl
New or increased O2 requirement to maintain SP O2 >90%
Decreased UOP
Platelet count <100,000
Coagulopathy (INR>1.5 or PTT>60sec)
= SEVERE SEPSIS

SEVERE SEPSIS + Clinical features are the same as severe sepsis with:
- Profound hypotension SBP<90, MAP<65 despite fluid resuscitation
- Lactate >4 mmol/L
= **SEPTIC SHOCK**
Transfer to ICU

Maternal Sepsis Pathway Interventions

SEPSIS

Once PT screens positive for SEPSIS get bedside evaluation from Attending MD for confirmation of diagnosis:

Then:

Interventions for 1st Hour of *Sepsis*:

Draw Lactate, CBC
IV access
Blood Cultures (2 sets, prior to antibiotics if possible)
Broad spectrum antibiotics
Consider:
CMP, PT/PTT, creatinine
UA
RRT

SEVERE SEPSIS

IV fluids NS (see orders)
Consider calling RRT
Repeat Lactate q4 hours
Strict I&O

SEPTIC SHOCK

Mortality with septic shock = 40-60%

Call RRT
ICU Admit
IV bolus

Case Study

HPI: [redacted] is a 32 y.o. G2P1001 who presents at 25w5d with complaints of *nausea/vomiting, left upper quadrant/side pain*

Patient believes she had strawberries that may have been bad. She noted vomiting (no real nausea prior) and had a bm, which improved the pain, but it did continue, and she came in to be seen. She had vomiting x 2 in labor and delivery. She was given IV fluids x 2 liters, and still had some pain, and requested pain medication.

Vitals	
Temp	36.7 (98)
Temp src	*Oral
Pulse	110
Resp	18
BP	123/77
SpO2	99
Oxygen Device	*None (Room a...
Height	162.6 cm
Weight	74.844 kg

Fetal Heart Rate		
Movement		Present
Mode		External US
Doppler Rate		
Baseline Rate		145
Baseline Classification		Normal
Variability		
Accelerations		10x10 bpm (pr...
Decelerations		
Type of Deceleration		
FHR Pattern Other		
Pattern Observations		
FHR Category		Category I

How Would You Screen this Patient?

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Case #2, Visit #2

HPI: [redacted] 32 y.o. G3 P1011, EDC 10/26/17, who presents at 26w1d with c/o recurrent left sided abdominal pain and N/V. Reports fever at home 100.4.

She was tx'd for UTI last week, sx resolved. Then 3 days ago she developed this left sided pain and N/V and thought it was "food poisoning". Was seen on L&D and her sx's improved over the next couple of days. She went to work and developed URI sx with sore throat (x 1 day) and nasal congestion. Denies cough, SOB, CP, back pain, HA, GU sx, or LE pain. No VB, LOF, or dec FM. Pain is constant so she states no regular ctxs.

PNC o/w unremarkable

Past Medical History:
Past Medical History:

Diagnosis	Date
• Urinary tract infection *was taking medication and has completed, 2 w ks ago*	

34

Do you suspect new or worsening condition?

- 1. yes
- 2. no

Arrival VS

Vitals			
Temp		36.8 (98.3)	
Temp src		*Oral	
Pulse		134	
Resp		16	
BP		124/57	
SpO2			
Oxygen Device			
Height			
Weight			75 kg

Fetal Heart Rate			
Movement		Present	
Mode		External US	External US
Doppler Rate			
Baseline Rate			170
Baseline Classification			Tachycardia
Variability			Moderate (Bet...
Accelerations			10x10 bpm (pr...
Decelerations			Accelerations

16

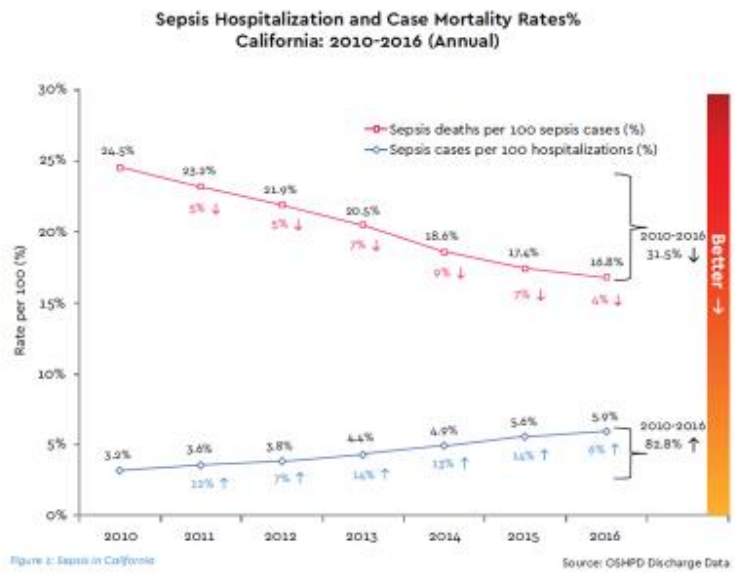
How would this pt screen?

- 1. positive
- 2. negative

Screen Review

Treatment Bundle – order set

Teach Everyone, Any Chance You Get!



POST TEST – pink paper

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Appendix B:

Chart Audit Tool

Positive Sepsis Screen MR	**Lactate Drawn Y/N**	**Blood Cultures Y/N**	**Antibiotics within an hour Y/N**	**Fluid Resuscitation Y/N**	**Transfer to ICU Y/N**

Appendix C

Knowledge Test

Item
1. Maternal sepsis can lead to maternal mortality. Where does sepsis rank in maternal mortality is in the US? 1. 2nd 2. 3rd 3. 4th 4. 5th
2. How can health professionals decrease the mortality rate associated with maternal sepsis? 1. Early identification and treatment 2. Selecting appropriate antibiotic treatment 3. Early fluid resuscitation 4. Being aware of the disease process
3. A positive Systemic Inflammatory Response Syndrome (SIRS) indicates what? 1. Infection 2. Severe sepsis 3. Septic Shock 4. Moderate sepsis
4. Which SIRS criteria differs in the obstetric population? 1. HR, BP, Temp. 2. HR, RR, WBCs 3. HR, BP, WBCs 4. HR, RR, Temp.
5. When should antibiotics be started on a sepsis patient? 1. Within one hour 2. Within 2 hours 3. Within 3 hours 4. Immediately

6. What is the first priority for a patient who has a new diagnosis of severe sepsis? 1. Prepare for transfer 2. Monitor Urine output 3. assess for adequate IV access to administer fluids & antibiotics 4. review all lab results and complete documentation
7. Time zero is when the following are present: 1. suspected/conformed infection 2. organ dysfunction 3. two or more SIRS criteria 4. All of the above
8. 30 YOF 2d PP with first baby s/p normal vaginal delivery presents with fever, chills & urinary frequency. Current VS: 101.2, 124, 24, 112/58, 98% RA. How would you screen the patient? 1. positive 2. negative
9. Patients in obstetric services should be assessed for sepsis? 1. once a day 2. once per stay 3. once per shift 4. when the physician asks
10. When should a patient be transferred to ICU (per policy)? 1. When sepsis is identified 2. When severe sepsis is identified 3. When septic shock is identified 4. After she delivers her baby

Appendix D:

Content Validity Index Table

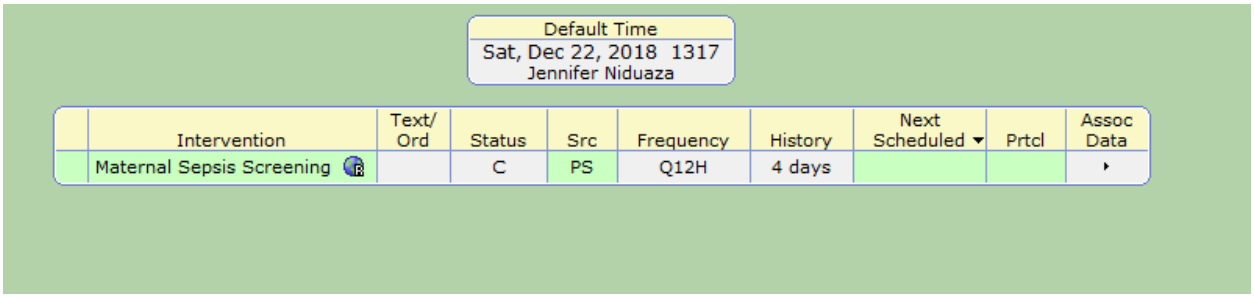
Item	Expert 1	Expert 2	Expert 3	Mean
1	2	4	4	3.33
2	2	4	4	3.33
3	3	4	4	3.67
4	4	4	4	4.0
5	3	4	4	3.67
6	4	4	4	4.0
7	3	4	4	3.67
8	4	4	4	4.0
9	4	4	4	4.0
10	4	4	4	4.0

Mean total of all means = 3.77

Appendix E:

Maternal Sepsis Meditech Assessment

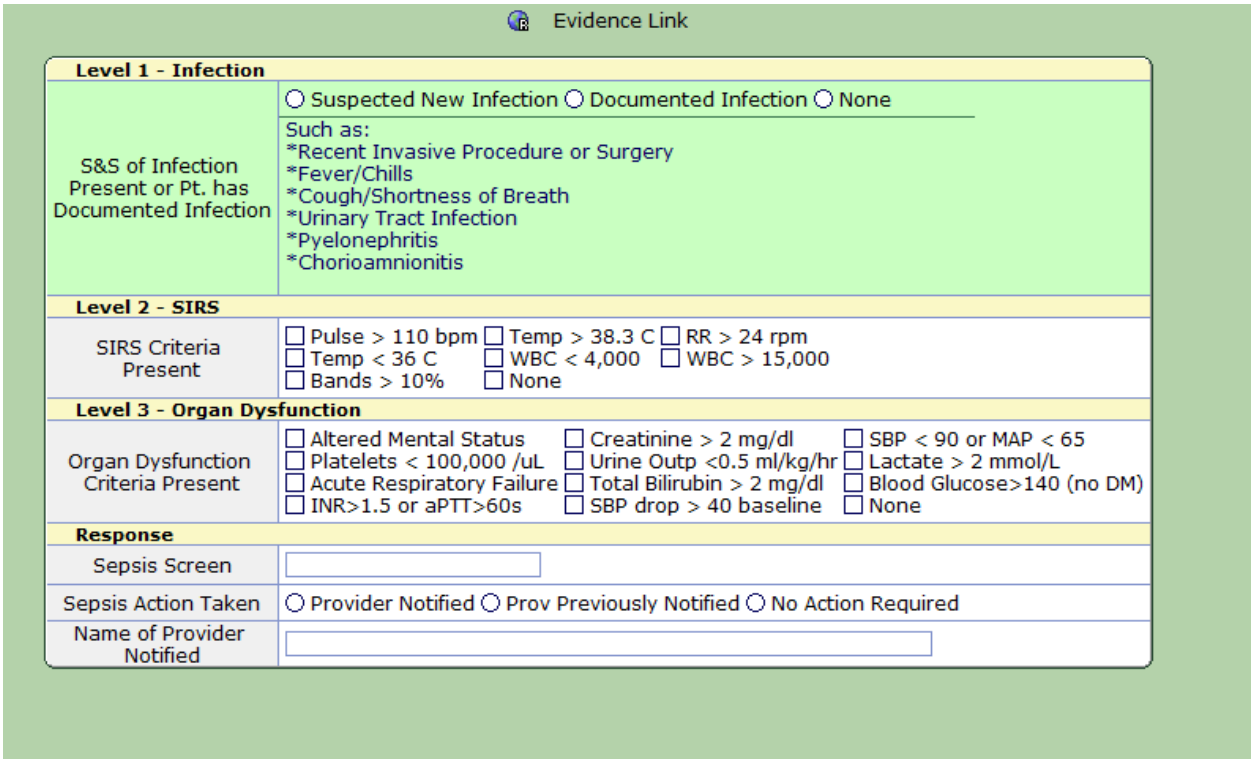
Maternal Sepsis Screen in Meditech



Default Time
Sat, Dec 22, 2018 1317
Jennifer Niduaza

	Intervention	Text/ Ord	Status	Src	Frequency	History	Next Scheduled	Prtcl	Assoc Data
	Maternal Sepsis Screening		C	PS	Q12H	4 days			

Screening Criteria



Evidence Link

Level 1 - Infection	
S&S of Infection Present or Pt. has Documented Infection	○ Suspected New Infection ○ Documented Infection ○ None Such as: *Recent Invasive Procedure or Surgery *Fever/Chills *Cough/Shortness of Breath *Urinary Tract Infection *Pyelonephritis *Chorioamnionitis
Level 2 - SIRS	
SIRS Criteria Present	☐ Pulse > 110 bpm ☐ Temp > 38.3 C ☐ RR > 24 rpm ☐ Temp < 36 C ☐ WBC < 4,000 ☐ WBC > 15,000 ☐ Bands > 10% ☐ None
Level 3 - Organ Dysfunction	
Organ Dysfunction Criteria Present	☐ Altered Mental Status ☐ Creatinine > 2 mg/dl ☐ SBP < 90 or MAP < 65 ☐ Platelets < 100,000 /uL ☐ Urine Outp <0.5 ml/kg/hr ☐ Lactate > 2 mmol/L ☐ Acute Respiratory Failure ☐ Total Bilirubin > 2 mg/dl ☐ Blood Glucose>140 (no DM) ☐ INR>1.5 or aPTT>60s ☐ SBP drop > 40 baseline ☐ None
Response	
Sepsis Screen	
Sepsis Action Taken	○ Provider Notified ○ Prov Previously Notified ○ No Action Required
Name of Provider Notified	

Appendix F:

Assessment Audit Tool

Positive Sepsis Screen MR	**Bedside evaluation within 15 minutes Y/N**	**If No, how long?**

Appendix G:

Maternal Sepsis Guideline and Pathway

GUIDELINE: MATERNAL SEPSIS GUIDELINE	**NUMBER: WCS-1 (new)**
Responsible: Director of WCS **Date** Reviewed / No Changes: Reviewed & Revised:	**Approvals** **Date** Committee 2/2019 MEC

PURPOSE:

- To provide evidence-based guidelines for the early diagnosis and treatment of pregnant or postpartum patients exhibiting signs of sepsis, severe sepsis, or septic shock in the Labor and Delivery (LDU) or Mother Infant Unit (MIU).
- To put into place a consistent treatment plan for patients.
- To establish a Women's and Children's Services (WCS) team response for implementation of sepsis management.
- ***This is a guideline for care: however, individualized medical care is directed by the physician.***

KEY POINTS:

Sepsis and septic shock are medical emergencies. All patients in the LDU will be screened for sepsis, severe sepsis and septic shock. Patients who screen positive will be managed utilizing these evidence-based guidelines.

Maternal sepsis is managed in the same ways as adult sepsis, however screening criteria differs slightly based on the physiological changes of pregnancy. These changes will be updated in the sepsis screening assessment based on evidence-based guidelines.

DEFINITIONS:

- Sepsis is a continuum which begins with a localized infection that triggers a systemic response, called the Systemic Inflammatory Response Syndrome (SIRS).
- **Sepsis** is a suspected or confirmed infection plus 2 or more of the SIRS criteria.
- **Severe sepsis** is sepsis with 1 or more organ dysfunctions due to tissue hypoperfusion.
- **Septic Shock** is severe sepsis + persistent hypotension or new onset hypotension despite fluid resuscitation and/or requires vasopressors, or a lactic acid of ≥ 4.0.
- **Maternal Sepsis** occurs during pregnancy or up until 8 weeks postpartum.
- **Hypotension:** SBP< 90 or MAP <65 or decrease of 40mmHg from normal SBP
- **Maternal SIRS criteria:** A clinical response from a nonspecific insult, including 2 or more of the following:
  - Temperature: > 38°C or < 36°C [>100.4°F or < 96.8°F]
  - Heart Rate: > 110 beats/min
  - Respiration: > 24/min
  - WBC Count: > 15,000/mm3 or <4,000/mm3 or > 10% immature neutrophils
  - Altered mental status
  - Glucose > or equal to 140 in the absence of diabetes

PROCEDURE:

A. SCREENING FOR SEPSIS:

Screenings include sequential assessments for SIRS, sepsis, and severe sepsis and septic shock. All obstetric patients are screened for sepsis during assessments by health care professionals at the following times:

1. On admission to LDU and/or MIU.
2. Every shift.
3. Change of patient status or concern of infection.

Once the patient screens positive for sepsis an attending physician will evaluate the patient at the bedside. Once sepsis is confirmed by the physician the following interventions are done:

- Draw a lactate and CBC
- IV access
- Order blood cultures (2 sets, prior to antibiotics if possible)
- Broad spectrum antibiotics

- Consider: CMP, PT, PTT, UA

1 Hour Treatment Bundle: To be started within one hour of diagnosis of sepsis.

1. Obtain lactate level
2. Order for STAT blood cultures x2. If blood cultures are delayed >45 minutes do not wait to start antibiotics. Notify provider.
3. Administer broad spectrum antibiotics
4. Treat hypotension or lactate >4 mmol/dL with 30ml/kg normal saline (NS).

B. IDENTIFICATION OF SEVERE SEPSIS

1. Process:

- If the initial sepsis screen is positive the RN will notify the charge nurse and the attending physician
- The team will look for acute organ dysfunction
- **Organ dysfunction:**
  - Lactate >2mmol/L
  - SBP<90 or MAP<65 and HR>100 bpm or SBP decrease <40 from baseline
  - Bilirubin >2mg/dL
  - New or increased O2 requirements to meet >90% SP O2
  - Urine output <0.5 mL/kg/hour for 2 hours
  - Platelet count <100,000
  - Coagulopathy (INR >1.5 or PTT >60 sec.)

C. IDENTIFICATION OF SEPTIC SHOCK

1. Process:

- If acute organ dysfunction and severe sepsis is identified:
  - fluid resuscitation with 0.9% NS
  - Rapid Response Team (RRT) will be called
  - Lactate will be ordered q6hours
  - Strict I&Os
  -
- **If persistent hypotension or new onset hypotension despite bolus or lactate >4mmol/L consider the patient may be in SEPTIC SHOCK and:**
  - Move pt to ICU (if possible)
  - IV bolus

- **Criteria for determining persistent hypotension or new onset hypotension:** In the one hour following the 30ml/kg fluid bolus completion there are 2 consecutive BPs of systolic blood pressure <90 or MAP <65 or physician documentation of a > 40 mmHg decrease in SBP from baseline and is related to infection, severe sepsis or septic shock, and not other causes.

D. RESUSCITATION BUNDLE ELEMENTS: These are evidence-based, and will be used as a guideline for management of patients with severe sepsis, septic shock. The "Obstetrics Severe Sepsis and Septic Shock Order Set" contains orders for these elements.

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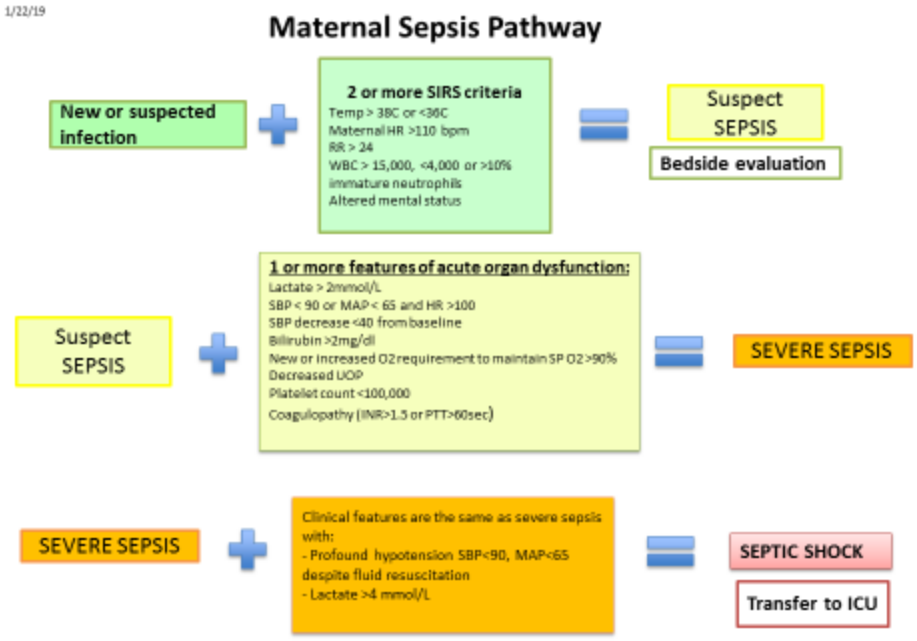
Bauer, M.E., Bauer, S. T., Rajala, B., MacEachern, M.P., Polley, L.S., Childers, D. & Aronoff, D. (2014). Maternal physiologic parameters in relationship to systemic inflammatory response syndrome, *Obstetrics & Gynecology, 124*(3), 535-541. Retrieved from http://www.ebscohost.com

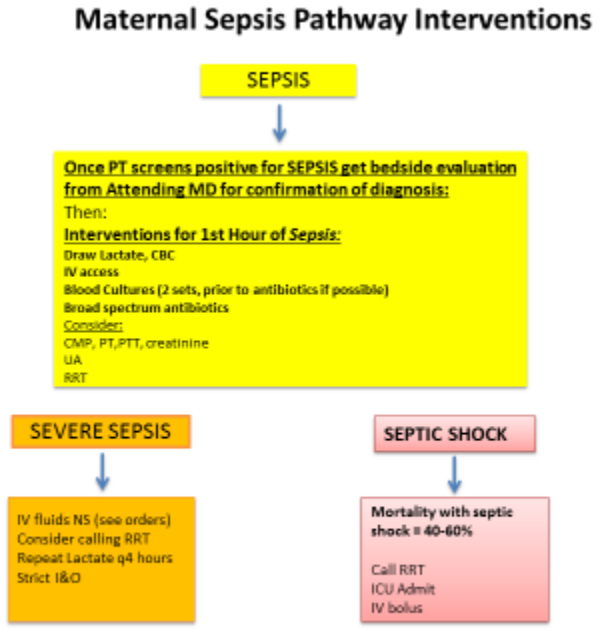
Faksh, A. & Martin, S. (2016). Maternal sepsis: Current approaches to recognition and clinical management, *Current Women's Health Reviews, 12*, 20-38. Retrieved from http://www.ebscohost.com

Levy, M.M., Evans, L.E. & Rhodes, A. (2018). The surviving sepsis campaign bundle: 2018 update, *Critical Care Medicine, 46*(6), 997-1000. DOI:10.1097/CCM.0000000000003199

Olvera, L. & Dutra, D. (2016). Early recognition and management of maternal sepsis, *Nursing for Women's Health, 20*(2), 183-195. Retrieved from http://www.ebscohost.com

Maternal Sepsis Flow Pathway


1/22/19
Maternal Sepsis Pathway
New or suspected infection
2 or more SIRS criteria
Temp > 38C or <36C
Maternal HR >110 bpm
RR > 24
WBC > 15,000, <4,000 or >10% immature neutrophils
Altered mental status
Suspect SEPSIS
Bedside evaluation
Suspect SEPSIS
1 or more features of acute organ dysfunction:
Lactate > 2mmol/L
SBP < 90 or MAP < 65 and HR >100
SBP decrease <40 from baseline
Bilirubin >2mg/dl
New or increased O2 requirement to maintain SP O2 >90%
Decreased UOP
Platelet count <100,000
Coagulopathy (INR>1.5 or PTT>60sec)
SEVERE SEPSIS
SEVERE SEPSIS
Clinical features are the same as severe sepsis with:
- Profound hypotension SBP<90, MAP<65 despite fluid resuscitation
- Lactate >4 mmol/L
SEPTIC SHOCK
Transfer to ICU


Maternal Sepsis Pathway Interventions
SEPSIS
Once PT screens positive for SEPSIS get bedside evaluation from Attending MD for confirmation of diagnosis:
Then:
Interventions for 1st Hour of Sepsis:
Draw Lactate, CBC
IV access
Blood Cultures (2 sets, prior to antibiotics if possible)
Broad spectrum antibiotics
Consider:
CMP, PT,PTT, creatinine
UA
RRT
SEVERE SEPSIS
IV fluids NS (see orders)
Consider calling RRT
Repeat Lactate q4 hours
Strict I&O
SEPTIC SHOCK
Mortality with septic shock = 40-60%
Call RRT
ICU Admit
IV bolus