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Current Key Challenges in Managing Maternal Sepsis

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ABSTRACT

Sepsis resulting from maternal infection is the second leading cause of pregnancy-related death. Although screening and initial care of a septic nonpregnant patient is standardized in nonpregnant adults, many challenges exist for early recognition and management of sepsis and septic shock in the obstetric population. Because most sepsis research excludes pregnant patients, there are many challenges that contribute to a lack of standardized approach to maternal sepsis. These challenges include inconsistent early warning sign criteria, lack of validated screening tools, adaptation of bundle components for maternal physiology, delivery considerations, and knowing when to transfer the patient to a higher level of care. To overcome these challenges, reduce variation in care, and improve patient outcomes, it is important for clinicians to plan, practice, and implement a maternal sepsis bundle.

Key Words: lactate, maternal sepsis, obstetric sepsis, sepsis bundle, septic shock

Sepsis is a pathophysiologic, dysregulated host response to infection that results in organ dysfunction and/or failure. Sepsis may progress to septic shock leading to profound circulatory and metabolic abnormalities with increasing mortality; both are medical emergencies requiring prompt recognition and treatment to minimize morbidity and mortality.[1] In the United States, sepsis is the second leading cause of pregnancy-related death, an increase from previous rankings. An estimated 12.5% to 23% of all maternal deaths are sepsis related.[2,3]

The timing of maternal sepsis-related deaths varies through the antepartum, intrapartum, and postpartum periods. During pregnancy and the first week postpartum, sepsis ranks as the third leading cause of pregnancy-related death. However, beyond the first week through the 6 weeks postpartum, sepsis is the leading cause of death.[4] Approximately 17% of maternal sepsis-related deaths occur during delivery hospitalization and 38% occur after delivery discharge, highlighting the risk of sepsis for postpartum patients.[2]

Maternal sepsis originates from obstetric and nonobstetric etiologies. Risk factors include multiple gestation, prolonged ruptured membranes, urinary tract infection and stillbirth in the antepartum period, cesarean or operative vaginal birth, hemorrhage, manual placental extraction or curettage, and retained products of conception in the postpartum period.[5] In addition to physiologic or pregnancy-related risks, structural and social determinants of health associated with higher risk for sepsis include low socioeconomic status, Black race, and public or no health insurance coverage.[6]

In efforts to standardize and promote evidence-based management, the Surviving Sepsis Campaign (SSC), an international collaborative organization, publishes recommendations and clinical tools for management of patients with known or suspected sepsis. In 2018, the SSC guidelines (SSC3) simplified diagnostic definitions into sepsis and septic shock and grouped priority interventions into a 1-hour bundle.[7] Even though obstetric considerations were not specifically identified when establishing these guidelines and most scientific data

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utilized in the development of the SSC3 bundle excluded pregnant patients, implementation of these basic principles in obstetrics is still recommended.[8] However, many clinical and administrative challenges exist, which have hindered obstetric services from implementing and operationalizing a standardized approach to maternal sepsis. In this article, key challenges in screening, recognition, and management of maternal sepsis have been identified and discussed.

CHALLENGE 1: LACK OF AWARENESS AND RECOGNITION

Sepsis bundles have been successfully implemented in hospitals for many years, but exclusion of the obstetric population in these programs has contributed to a lack of awareness of the severity of maternal sepsis outcomes and need for standardized screening and management. In recent years, increased efforts to reduce preventable maternal morbidity and mortality due to obstetric hemorrhage and severe hypertension have led to protocolized care and improvements in maternal outcomes.[9] Many of these efforts have been led by state perinatal quality collaboratives with hospital implementation of safety bundles that include evidence-based management recommendations and interprofessional education on these topics. However, despite the significant rise in infection and sepsis contributing to pregnancy-related deaths, equally widespread efforts to improve readiness, recognition, and response to maternal sepsis are lacking.

Maternal mortality reviews have demonstrated consistent deficiencies in awareness and recognition of early warning signs of maternal sepsis.[10–12] Lack of awareness of an issue increases the likelihood that recognition will be delayed. A key physiologic factor in a pregnant patient is impaired immunologic response(s) that increases the risk for infection and serious complications.[13] Additional changes in maternal physiology along with lack of a classic presentation for maternal sepsis can be problematic and lead to delays in recognition, diagnosis, and treatment.[5] The clinical presentation is usually dependent on the causative organism(s), site of infection, and the patient's comorbidities.[14] In the absence of septic shock, a pregnant patient with sepsis may appear deceptively well, delaying recognition.

CHALLENGE 2: EARLY WARNING SYSTEMS AND TOOLS

Since 1997, sepsis scoring tools and early warning signs have been widely used in the nonobstetric patient population to identify infected patients at risk for morbidity and mortality and predict the likelihood of intensive care unit (ICU) admission.[15] Although the adoption of maternal early warning signs and symptoms has been strongly recommended since 2007,[16] implementation in many units has been limited to provider order sets without screening tools, defined responses, education, and team training.[17] Modifications to current sepsis screening tools are required due to the fundamental physiologic changes of pregnancy. However, precise early warning signs that balance accuracy of sepsis screening while limiting false-positive alarms in a pregnant patient have not been consistently defined nor adequately studied.[18,19]

Several maternal early warning systems and triggers exist but lack consistent values, making it difficult to determine the correct triggers.[20] Most systems include assessment of core vital signs. However, some exclude maternal temperature, while others include multiple other parameters such as fetal heart rate and maternal mental status or nursing concern. Additionally, pathophysiologic thresholds for abnormal core vital signs (blood pressure, heart rate, respiratory rate, and temperature) vary widely among systems. In several systems, respiratory rate values are not considered abnormal until less than 10 or greater than 30 breaths per minute.[21–25] This is concerning, as notification to a provider or bedside response may not occur until respirations reach 8 or 32 breaths per minute. Table 1 outlines current maternal early warning sign tools and systems.

Compounding the problem is the potential for dismissal of early warning signs and symptoms in a generally young and healthy patient population. Progression from early warning signs to a diagnosis of sepsis or septic shock occurs along a continuum, with progression of deterioration at a rapid rate in some patients. Therefore, it is vital to recognize and act on abnormal assessment parameters and avoid normalization of deviance. Because pregnancy is a normal physiologic process with numerous cardiovascular and hemodynamic changes, assessment parameters that fall outside defined parameters are often normalized. An example of normalization of deviance in a patient with sepsis is assuming maternal tachycardia or tachypnea to be caused by pain or anxiety and hypotension assumed to be normal for pregnancy.

Accurate and comprehensive assessment is essential for early recognition of compromise in maternal sepsis. Multiple studies highlight missing or inconsistent vital sign data as a limitation and an area for improvement in sepsis screening and treatment.[28,30,31] In most clinical units, vital signs are measured by automated machines with values recorded directly into the electronic health record (EHR). However, vital signs that

Table 1. **Maternal early warning tools and triggers**

***Triggers*: Single severely abnormal variable or combination of mildly abnormal variables**
***Tool*: Combination of a variety of clinical observations (VS, laboratory, physical findings) to identify patterns indicating worsening clinical status**

Early warning system and year introduced	Type of system	Key points	Data on performance
Systemic Inflammatory Response System (SIRS) criteria 1991[26]	Triggers	Not specific to obstetrics	Performs poorly for predicting sepsis in obstetric patients: • 93% sensitive; 63% specific[27]
United Kingdom Maternal Early Obstetric Warning System (MEOWS) 2007[16]	Tool	Utilized in obstetric units in the UK Assigns score for abnormal triggers Score assigned dictates next actions	*2 validation studies* Prospective validation of over 600 obstetric patients Interventions dictated by MEOWS algorithm in use For predicting maternal morbidity: • 89% sensitive; 79% specific PPV 39%; NPV 98%[21] Prospective chart review on over 1000 obstetric patients No interventions prescribed in the study For predicting maternal morbidity: • 86% sensitive; 85% specific PPV 54%; NPV 97%[22]
Irish Maternity Early Warning System (IMEWS) 2013[25]	Tool	Utilized for all hospitalized pregnant and postpartum women in Ireland Assigns score for abnormal triggers Score assigned dictates next actions	Not available
NPMS Maternal Early Warning Criteria (MEWC) 2014[23]	Triggers	Modification of MEOWS red triggers (most severe)	Not available
Maternal Early Warning Trigger Tool (MEWT) 2016[24]	Tool	Modification of MEWC triggers Intended to identify 4 of the major causes of maternal morbidity: • Sepsis • Cardiovascular dysfunction • Hypertension and preeclampsia severe features • Hemorrhage Prospectively implemented in 6 hospitals Combinations of abnormal triggers suggest next actions	Screened over 11 000 obstetric patients Sepsis most common reason for ICU admission and most common diagnosis in patients who screened positive For ICU admission: • 96.9% sensitive; 99.9% specific PPV 12.0%; NPV 99.99% 18.4% decrease in severe maternal morbidity 13.6% decrease in composite maternal morbidity
Maternal sepsis-specific tools			
Sepsis in Obstetrics Score (SOS) 2014[28]	Tool	Specific to suspected sepsis patients Includes larger variety of triggers compared with other tools Assigns score for abnormal triggers Score assigned predicts likelihood of ICU admission for sepsis	Prospectively validation of over 400 patients who screened positive Score ≥6 demonstrates increased risk for ICU admission: • AUC of 0.85 (95% CI, 0.76-0.95)[29]
CMQCC 2-Step Method for Sepsis Screening 2019[9]	Tool	Modified SIRS criteria for pregnancy using 2 SD from mean as range of normal 2-step process for sepsis screening Results of screening process suggest next actions	No peer-reviewed publications available. Only data available are extracted from clinical practice data sets, not formal research studies and published on the CMQCC Web site Data from over 14 000 patients: • 97% sensitive; 99% specific

Abbreviations: AUC, area under the curve; CI, confidence interval; CMQCC, California Maternal Quality Care Collaborative; ICU, intensive care unit; NPMS, National Partnership for Maternal Safety; NPV, negative predictive value; PPV, positive predictive value; SD, standard deviation; VS, vital signs.

are obtained from other measures, such as temperature and respiratory rate, may be omitted. Increased respiratory rate is one of the first vital signs to change in a septic patient, indicating changes in homeostasis and potential for metabolic acidosis. Therefore, it is critically important to accurately assess the respiratory rate to determine whether the patient is showing early signs of deterioration.[9,27] Incomplete or inaccurate vital signs delay recognition and may result in adverse outcomes.[27]

CHALLENGE 3: LACK OF KNOWLEDGE

Implementation of sepsis bundles for pregnant and postpartum patients has been delayed or lacking entirely, for many reasons. As a result, many obstetric clinicians lack knowledge regarding sepsis pathophysiology and management principles and may not recognize evidence of deterioration. Furthermore, if hospital data abstracted for quality improvement measures do not include pregnant or identify postpartum patients, this may lead to a lack of accurate data and contribute to confusion on the severity and incidence of maternal sepsis within an organization. For example, a postpartum readmission for sepsis may not be categorized as an obstetric complication.

Compounding the problem, patients lack knowledge regarding the significance of specific signs and symptoms related to sepsis and when to seek care.[11] This leads to further delays in diagnosis and treatment. If prevention of maternal morbidity and mortality from sepsis is not prioritized on a national and local level, then education about the issue is likely to be lacking and lead to further knowledge deficits for those caring for these patients. Deficiencies in structured medical education and training in obstetric critical care are addressed in the following challenge.

CHALLENGE 4: INTENSIVE CARE UNIT TRANSFER

Another key challenge for obstetric teams involves the decision to transfer the pregnant septic patient to a higher level of care. Without a standardized approach to sepsis screening for pregnant patients, establishing criteria for ICU admission is more difficult and left to physician discretion. As a result, pregnant patients are more likely to be transferred to an ICU setting when they are overtly critically ill (ie, requiring intubation) or in shock requiring vasopressor support.

Once a pregnant patient is transferred to an adult ICU, it is imperative to remember that many care team members lack education in or understanding of key physiologic and hemodynamic changes of pregnancy that will impact care. Beyond this, physician training programs for obstetricians, anesthesiologists, and intensivists contain very little education in obstetric critical care.[8,32] Caring for a pregnant patient is potentially intimidating for those who lack adequate training and experience, which may impact the willingness to admit and/or care for pregnant women in the adult ICU.

Once in the adult ICU, the role of the obstetric team is to assist other clinicians who are unfamiliar with maternal and fetal pathophysiology and the impact on patient care needs. As experts in care of complicated pregnancies, comanagement by a maternal-fetal medicine (MFM) specialist is recommended in an adult ICU.[33] If MFM support is not available, then consideration should be given to transferring the patient to a facility with a higher level of care. Basic interventions such as lateral uterine displacement positioning to prevent vena cava compression, remaining at bedside for electronic fetal monitoring, initiating intrauterine resuscitation, or assisting the postpartum patient with breastfeeding, pumping, and perineal care are examples of collaborative care between ICU and obstetrical nursing teams. Similarly, the obstetric nurse may have very little knowledge or experience with ICU interventions such as ventilator management or vasopressor infusion. This mutual lack of understanding may lead to communication gaps among members of the care team.

CHALLENGE 5: IMPLEMENTATION OF A MATERNAL SEPSIS BUNDLE AND PROTOCOLIZED CARE

When maternal sepsis is suspected, timely implementation of bundle components while evaluating and addressing the pregnancy is crucial. Pregnancy should not restrict fundamental sepsis diagnostic, pharmacologic, or resuscitative management principles including fluid resuscitation, correction of hypotension, and timely administration of antibiotics. In addition, it is recommended that initiation of bundle components be initiated in the obstetric unit and not be delayed for transport to an ICU environment, another unit, or hospital.[18] Key maternal physiologic and hemodynamic changes are considered when implementing the SSC3 recommendations and are outlined in the following bundle components.

Fluid resuscitation

Given the challenges previously presented, sepsis is less likely to be recognized in the pregnant patient, increasing the likelihood of inadequate fluid management. Fluid resuscitation is crucial to maintain sufficient maternal cardiac output (CO) and organ perfusion. Uterine blood flow in the third trimester is approximately

500 to 750 mL/min, which reflects greater than 20% of maternal CO demands.[34] Sepsis leads to diffuse capillary injury and increased capillary permeability. Pregnant patients also have lower colloid oncotic pressure, which is further exacerbated by crystalloid fluid resuscitation. This results in an increased risk of third spacing of fluids and complications related to noncardiogenic pulmonary edema, cerebral edema, left ventricular diastolic dysfunction due to ventricular wall edema, decreased organ perfusion, and higher mortality.[35–39]

Recommendations for volume resuscitation vary with respect to the amount of intravenous (IV) fluid and rate of administration. The 1-hour SSC3 bundle recommends rapid IV administration of a 30-mL/kg bolus for hypotension or lactate levels greater than or equal to 4 mmol/L but does not include guidelines specific to pregnant women.[1] Other groups have differing recommendations for volume resuscitation. In Step 2 of the California Maternal Quality Care Collaborative (CMQCC) Maternal Sepsis Toolkit, 1 to 2 L of IV fluids is recommended if infection is suspected, increasing to an initial fluid resuscitation of 30 mL/kg within 3 hours if sepsis is confirmed.[9] However, the Society for Maternal Fetal Medicine (SMFM) states that the SSC3 requirement is overaggressive and recommends a standard initial bolus of 1 to 2 L of crystalloids if hypotension or clinical signs of hypoperfusion are present.[40]

Once initial volume resuscitation is completed, the rate for additional fluid infusion is individualized based on hemodynamic reassessment.[9,40] Obstetric providers have less experience and comfort in performing advanced hemodynamic assessment compared with nonobstetric providers. Multiple approaches can be utilized to assess hemodynamic response to fluid. These include bedside transthoracic cardiac echocardiogram, noninvasive CO monitoring, or dynamic assessment of fluid responsiveness with passive leg raise and/or an additional fluid challenge. Passive leg raises may not be as reliable in the third trimester of pregnancy due to inferior vena cava compression by the gravid uterus.[9,40,41]

In addition to the amount and rate of fluid resuscitation, the type of fluid used is a clinical consideration not delineated in obstetrics. Both normal saline (0.9% sodium chloride) and balanced crystalloids, such as lactated Ringers solution or Plasma-Lyte A, are common IV fluids used for volume resuscitation in obstetrics. However, patients who receive normal saline fluid resuscitation have a higher incidence of hyperchloremia, metabolic acidosis, renal vasoconstriction, hypotension, and inflammation.[42–46] In addition to crystalloid solutions, colloids (ie, 25% albumin) are frequently administered for rapid IV volume expansion, but evidence is lacking for improved outcomes. In sepsis patients, hydroxyethyl starches are not recommended due to evidence of increased mortality and acute kidney injury risks.[47]

Another clinical challenge involves thresholds for administering blood products with specific recommendations lacking in maternal sepsis bundles. Following administration of large quantities of crystalloid solutions, plasma proteins and hemoglobin levels become diluted. Additionally, red blood cell (RBC) lysis commonly occurs in sepsis, further decreasing hemoglobin and hematocrit levels and oxygen carrying capacity. Therefore, transfusion of RBCs is considered with a hemoglobin value below 7 g/dL.[1] In the presence of disseminated intravascular coagulopathy, clotting factor replacement with fresh frozen plasma, cryoprecipitate, and platelets are critical components of hemostatic resuscitation.

Lactate

Serum lactate levels can reflect tissue perfusion and guide resuscitation efforts. Rising lactate levels may reflect poor tissue perfusion resulting in anaerobic metabolism, which leads to metabolic acidosis if not reversed.[1] Although the quality of evidence is low, SSC3 guidelines recommend drawing a serum lactate level in the 1-hour bundle and remeasuring in 2 to 4 hours if the initial value is greater than or equal to 2 mmol/L. However, in a laboring patient, lactate levels may exceed 2 mmol/L even in the absence of sepsis, making it difficult to determine diagnostic criteria and/or response to resuscitative measures.[27,48–50] In a nonlaboring pregnant patient with known or suspected sepsis, lactate levels are considered to be reliable and are utilized as a measure of tissue perfusion, as in the nonobstetric population. Elevated lactate levels in pregnant septic patients are associated with positive blood cultures, longer hospital stays, increased risk of ICU admission, fetal tachycardia, and preterm birth.[50]

Bacterial cultures and source control

Cultures drawn in the SSC3 1-hour bundle attempt to establish the causative organism(s) for tailored antimicrobial therapy. Aerobic and anaerobic blood cultures are obtained from 2 different sites, along with cultures from the presumptive site of infection.[1] Obtaining blood cultures is not a routine laboratory performed in obstetrics and therefore nursing staff may have difficulty completing within 1-hour time frame. If chorioamnionitis is suspected in the absence of labor, amniocentesis may be indicated.[51,52] Sepsis in pregnancy is typically bacterial and most likely to be the result of urinary tract infection, endometritis, chorioamnionitis, pneumonia, or gastrointestinal sources. Ultrasound, computed tomography (CT), or magnetic resonance imaging (MRI)

may be necessary to identify the infectious source.[53] Availability of radiology services may not be readily available in some hospitals, delaying or preventing utilization of these tools; however, continued bundle implementation is recommended until the patient may be transferred to a facility with necessary resources.[1]

Antimicrobial therapy

Due to increased mortality with delay in administration, timing of antibiotic initiation from diagnosis of maternal sepsis is a challenging quality measure linked to nursing care. In a recent study assessing timing of antibiotics, only 35.7% of patients received antibiotics within the first hour following maternal sepsis diagnosis, increasing mortality from 8.3% to 20% compared with patients receiving antibiotics in the first hour.[27] If sepsis is not suspected and identified in a timely manner, then antibiotic administration will be delayed, and morbidity and mortality impacted.

Management of hypotension

Hypotension (sustained mean arterial pressure [MAP] <65 mm Hg) in a septic patient must be addressed to improve tissue perfusion and maintain CO. Initiation and titration of an IV vasopressor is clinically indicated if the patient remains hypotensive and/or noncardiogenic pulmonary edema is evident following the initial IV fluid bolus.[40] Persistent hypotension and IV vasopressor administration require continuous electrocardiogram monitoring, arterial line placement, and ICU level of care. If this level of care cannot be provided in the obstetric unit, then the patient should be transferred to an adult ICU or an outside facility.

CHALLENGE 6: IF AND WHEN TO DELIVER

Delivery consideration is particularly challenging in a critically ill patient. The possibility of laboring and delivering in a location remote from the obstetric suite, neonatal nursery, and operating rooms increases the complexity for care teams. Delivery may be necessary due to spontaneous preterm or term labor, fetal indications including abnormal fetal heart rate pattern, or may be considered to improve maternal condition. Preterm birth is common in septic patients.[54] However, the birth process itself, whether vaginal or cesarean, may precipitate maternal decompensation. During contractions, blood is shunted into the systemic circulation from the uterine sinusoids, increasing CO 25% to 40% above baseline.[55] Pushing during the second stage of labor further increases CO by 50%.[55] In some scenarios, cesarean birth is considered over vaginal due to the patient's perceived inability to tolerate labor or because she is in an adult ICU.

Critically ill patients are at increased risk for surgical complications, particularly if they have respiratory failure.[56] If cesarean birth is indicated, preoperative stabilization of the patient is of paramount importance. Whether delivered vaginally or by cesarean, all patients experience a 75% increase in CO in the first hour postpartum. This increases the risk for third spacing of fluids and development of cardiogenic and noncardiogenic pulmonary edema in patients with sepsis and septic shock.[55]

Uterine vessels lack autoregulation, with perfusion dependent on adequate maternal MAP. Maternal shock results in splanchnic and uterine artery vasoconstriction, decreasing fetal oxygenation. Potential changes in fetal monitoring reflect fetal cardiac responses to hypoxia and include tachycardia, bradycardia, persistent minimal or absent baseline variability, and/or late decelerations if uterine activity is present. Fetal acidosis can occur with maternal sepsis; however, it is attributed to hypoxia due to impaired gas exchange rather than lactic acid in the maternal bloodstream.[28,51,57]

Despite these issues, delivery of a septic patient has not been demonstrated to improve maternal outcomes, unless the uterus is the source of the infection.[58] Therefore, delivery should be reserved for the usual obstetric indications and not performed solely for a diagnosis of sepsis or septic shock. Aggressive treatment of the patient, focusing on maintaining CO, tissue perfusion, managing blood pressure, antibiotic therapy, and source control, is prioritized. If assessment of the fetal heart rate tracing is abnormal, components of in utero resuscitation are considered and dependent on the pattern.[40]

DISCUSSION

When implementing a maternal sepsis bundle, it is important to identify barriers and outline a plan to address each barrier that may prevent complete implementation of each bundle component. In addition to the challenges listed in this article, other obstacles exist. In particular, obstetric patients need to be included in sepsis research. Prospective studies are necessary to evaluate performance of and determine a consensus on maternal early warning system criteria and more precise vital sign triggers that reflect maternal compromise. Determination of maternal serum lactate levels that reflect tissue hypoperfusion or dysfunction and not labor contractions is needed to improve recognition and compliance.

Most hospitals rely on built-in processes within the EHR to assist in recognition of sepsis and clinician

compliance with sepsis bundle implementation. However, these built-in EHR sepsis screening tools are typically not specific to obstetrics, and lead to the increased likelihood of false-positive alerts and alarm fatigue. Furthermore, EHR tools may not reflect the most current sepsis terminology or management parameters and making system changes in an EHR is a cumbersome process.

Standardization of healthcare practices and efforts to reduce variation in care improve patient outcomes and quality of care.[59] Processes open to standardization include determination of a maternal sepsis screening system, a written and practiced maternal sepsis protocol with a corresponding provider order set and checklist, and a well-defined scope of practice to determine when a patient requires higher level of care. A recent study compared compliance with the SSC3 bundle after implementing a standardized perinatal sepsis provider order set and sepsis protocol. Education emphasized early management and vigilance to providers, nurses, and supporting staff, including rapid response teams, pharmacy, and nursing leadership. Significant improvement was seen in obtaining lactate levels throughout the course of the bundle as well as timely antibiotic administration.[14]

Quality improvement initiatives for maternal sepsis require prioritization to improve early recognition, decrease time to bundle implementation, and identify gaps in care.[60] Utilizing a well-known quality improvement tool, a SWOT analysis may provide a planning methodology to build a strategic plan for implementation of a maternal sepsis bundle. Table 2 provides an example SWOT analysis.

Because time from diagnosis to treatment is related to morbidity and mortality, quality improvement initiatives often include timing measures to meet 1-hour bundle compliance goals. Therefore, the need for effective screening, timely recognition, and appropriate response to maternal sepsis is critical. To improve timing goals, team training, education, and practice are essential. Interprofessional and interdepartmental team members, representing all areas in the facility where a pregnant or postpartum patient may be cared for, should complete maternal sepsis drills to determine and understand current systems and processes that may delay care. In addition, education and training should focus on identifying maternal early warning signs and symptoms of sepsis and understanding how to escalate care in a coordinated response.

Lastly, a shift for clinical programs related to maternal care requires a proactive versus reactive prioritization, even in the presence of other competing maternal initiatives. To accomplish this, ease and standardization of data collection and reporting systems is essential for clinical leaders, hospital and state perinatal quality collaboratives, Departments of Health, and hospital associations to facilitate data distribution. Streamlined documentation requirements, resources and expertise for quality improvement, education, and simulation are needed. Development of discharge education materials

Table 2. **Example SWOT analysis**

Strengths	**Weaknesses**
• High-reliability organization • Motivation to implement best practice initiatives due to infection/sepsis #2 leading cause of pregnancy-related death in the United States • Get patient to right level of care • Improve knowledge, skills, and awareness • Goal to complete bundle components in recommended time frame • Nursing and medicine champions for bundle development and implementation	• Paucity of data • SSC3 bundle excluded pregnancy recommendations • Variation in maternal early warning parameters—lack of consensus from professional organizations • Lack of standardized approach to screening and managing maternal sepsis • Need for innovative postpartum sepsis discharge education • Need for inclusion of obstetrics in unit and hospital-wide sepsis initiatives
Opportunities	**Threats**
• Align pregnancy modifications to electronic health record for early warning systems • Include maternal sepsis in hospital quality improvement initiatives • Interprofessional training and simulation • Develop maternal sepsis provider order set and checklist • Develop screening process • Research	• Lack of clinical experts to develop bundle and education regarding maternal sepsis concepts • Reluctant attitudes • Lack of funding • Lack of willing champions for implementation and evaluation (nurse and provider) • Competing initiatives

that are dispersed to the patient in new and innovative formats and early postpartum assessment are crucial challenges to improve outcomes, which may be linked to reimbursement in the future.

CONCLUSION

Sepsis during pregnancy and the postpartum period remains a major contributor to pregnancy-related morbidity and mortality. Even though challenges exist, standardizing screening, defining maternal early warning criteria, and implementing a well-defined response with a maternal sepsis bundle are essential to improve care and outcomes.

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