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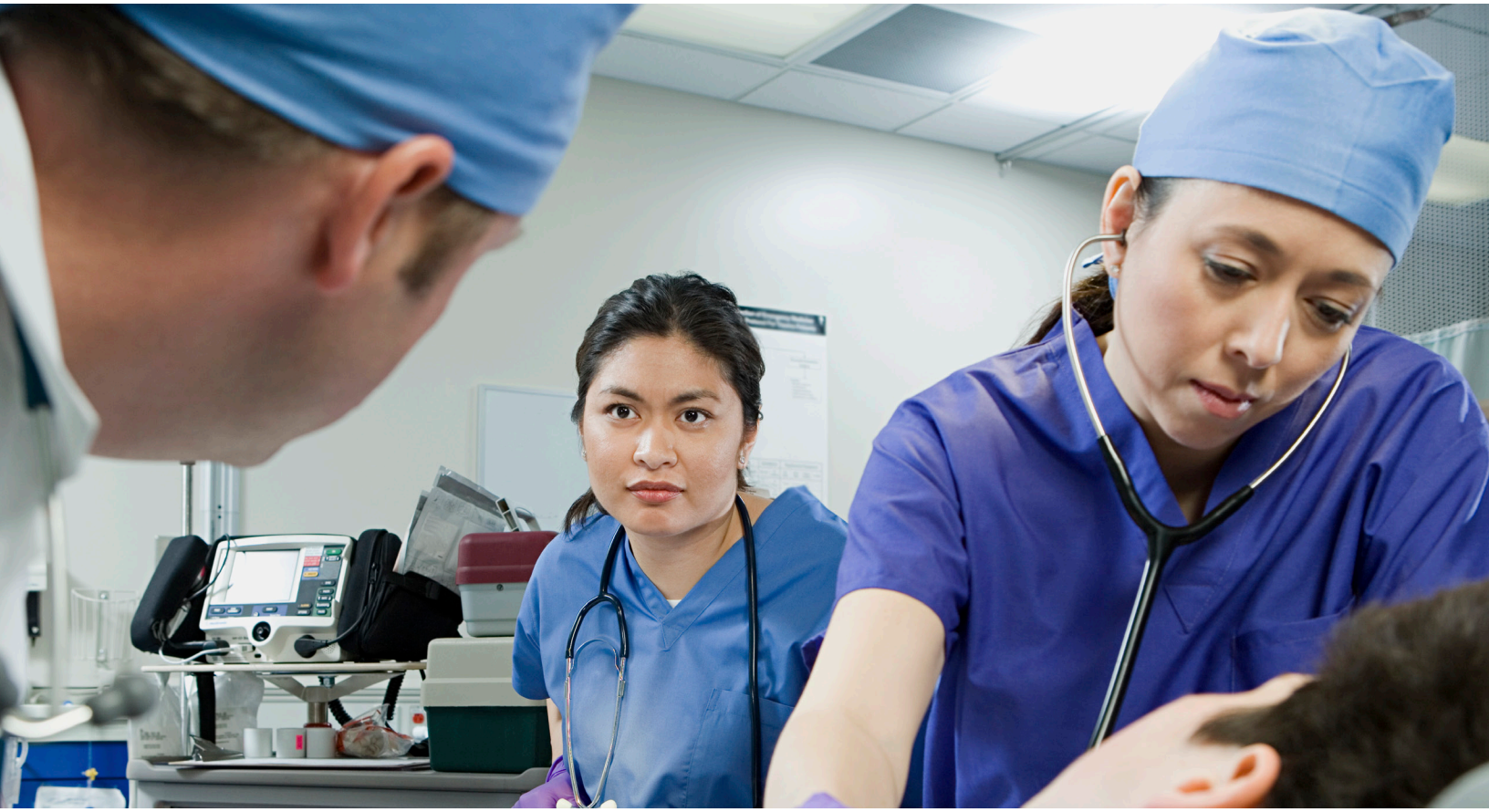

# Improving Diagnosis and Treatment of Maternal Sepsis

A CMQCC Quality Improvement Toolkit

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## January 2020

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# Executive Summary

## Introduction

Sepsis is an important cause of maternal morbidity and mortality. The Centers for Disease Control and Prevention notes that the proportion of U.S. maternal deaths from sepsis (12.7%) is similar to the proportion of deaths from obstetric hemorrhage (11.4%) and hypertensive disorders (7.4%).[1] It is estimated that 63 to 73% of maternal deaths from sepsis are preventable.[2-3] Furthermore, for each maternal death, there are 50 women who experience life-threatening morbidity from sepsis.[4] This is concerning, given that prompt recognition and rapid treatment of pregnant and postpartum women with sepsis usually results in good outcomes in this young and generally healthy population. Physiological changes of pregnancy can mask signs of sepsis (e.g. elevated heart rate, lower blood pressure and higher white blood cell count). Labor can further impact these physiologic parameters and significantly raise lactic acid levels.[5] As a result, the national sepsis criteria are not satisfactory for the obstetric population.[6-7]

Maternal sepsis may be caused by many different infections, notably in the genital tract, lung, wound, breast or gastrointestinal tract. Because a pregnant woman experiences physiological changes to her immune system, she may be more susceptible to developing severe infections.[8] While general supportive measures are useful for all persons with sepsis, the choice of specific antibiotics or source control procedures will be dependent on the specific infection.

Previous CMQCC clinical quality improvement toolkits for hemorrhage and hypertension have been instrumental in driving reductions in maternal mortality and morbidity, and there are similar opportunities for improving outcomes for women who experience maternal sepsis. We have created simple and practical approaches to care that make adoption of our CMQCC toolkits much more likely to succeed. The Sepsis Task Force Advisory Group included a multi-disciplinary team of experts from around California as well as consultants from outside the state. The editorial process was extensive, taking nearly a year. Several of the tools have been developed and recommended by national and international organizations including the American College of Obstetrics and Gynecology (ACOG), Society of Maternal Fetal Medicine (SMFM), Surviving Sepsis Campaign, Centers for Disease Control (CDC), and The Surgical Infection Society, and Infectious Diseases Society of America.[9-10]

A major finding of the Task Force was that current screening systems for sepsis used in other adults perform poorly in pregnancy. Accordingly, we developed and recommend a new, two-step approach for the diagnosis of sepsis during pregnancy and postpartum. The first screening step is limited to vital signs adjusted for pregnancy and the white blood cell count. The second diagnostic step uses evaluation for end organ injury with laboratory values adjusted for pregnancy where needed. This two-step approach allows for increased sensitivity and fewer missed cases with greater specificity with fewer false positives. The utility of lactic acid determinations during labor remains debatable. Nevertheless, women with elevated values require careful individual consideration.

For assessment and treatment of maternal sepsis, we recommend that clinicians act quickly upon recognition of sepsis and septic shock because sepsis is a medical emergency. We recommend that blood cultures be drawn when sepsis is confirmed even if antibiotic therapy has been initiated and that appropriate fluid resuscitation be initiated promptly. Women with sepsis should be monitored closely for response or lack of response to interventions, and effective team communication enables members to relay relevant information in a way that is clear and understood during bedside care and handoffs. We emphasize that early administration of antibiotics, ideally within one hour of presentation, is critically important in sepsis. The initial choice of antibiotics in critically ill patients is generally empiric and broad spectrum to cover most or all likely pathogens. For some infections such as some abscesses or necrotizing fasciitis, source control with surgical/percutaneous drainage or debridement, is needed and should be initiated in a timely fashion using the least invasive approach possible.

There are unique, special obstetric considerations in the case of maternal sepsis. We recommend that the timing of delivery in a pregnant patient who is septic should

be individualized, taking into consideration gestational age and maternal-fetal status. Choice of anesthesia for a patient with clinical signs and/or symptoms consistent with a diagnosis of sepsis or septic shock can be difficult. We recommend that avoidance of neuraxial procedures should be strongly considered in the risk assessment of these patients.

An important proportion of women will develop sepsis following discharge from the delivery hospitalization. Accordingly, every woman and at least one support person should receive discharge instructions on the danger signs of infection and sepsis. Instructions at every point of care should include ways to decrease infection risk, such as frequent hand washing. Finally, for women who have had sepsis, follow-up contact should be made within days after discharge.

A major finding of the Task Force was that current screening systems for sepsis used in other adults perform poorly in pregnancy. Accordingly, we developed and recommend a new, two-step approach for the diagnosis of sepsis during pregnancy and postpartum.

The goal of this toolkit is to guide and support obstetrical care providers and their hospitals and organizations to implement methods for timely recognition of sepsis and for an organized, evidence-based response for this life-threatening condition. Implementation of this toolkit is intended to improve safety in all birth facilities.

An educational slide set is available as a supplemental resource to help clinicians educate their teams about the Maternal Sepsis Toolkit.

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1. Creanga AA, Syverson C, Seed K, et al. Pregnancy-Related Mortality in the United States, 2011-2013. Obstet Gynecol 2017 Aug;130(2):366-373.
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# The Case for Improving Response to Maternal Sepsis

## Introduction

Sepsis is a leading cause of maternal morbidity and mortality. The Centers for Disease Control and Prevention notes that the proportion of U.S. maternal deaths from sepsis (12.7%) is similar to the proportion of deaths from obstetric hemorrhage (11.4%) and hypertensive disorders (7.4%).[1] In a recent California maternal mortality committee report it was estimated that 63% of maternal deaths from sepsis had a good or strong chance to have been preventable.[2-3] Furthermore, for each maternal death, there are 50 women who experience life-threatening morbidity from sepsis.[4] This is concerning, given that prompt recognition and rapid treatment of pregnant and postpartum women with sepsis usually results in good outcomes in this young and generally healthy population. Physiological changes of pregnancy can mimic signs of sepsis (e.g. elevated heart rate, lower blood pressure and higher white blood cell count). Labor can further impact these physiologic parameters and significantly raise lactic acid levels.[5] As a result, the national sepsis criteria are not satisfactory for the obstetric population.[6-7]

Sepsis may be caused by many different infections (Table 1) which can make the clinical scenario more complex.[6,8] A pregnant woman experiences physiological immune changes which allow tolerance to paternally derived fetal antigens, and she may be susceptible to developing more severe bacterial, fungal, or viral infections.[9] While general supportive measures are useful for all persons with sepsis, the choice of specific antibiotics or source control procedures will be dependent on the specific infection.

**TABLE 1.** Leading Causes of Maternal Sepsis

| Antepartum | Intrapartum/ Immediate Postpartum | Post-discharge |
|---|---|---|
| Septic abortion | Chorioamnionitis/intraamniotic infection | Pneumonia/influenza |
| Chorioamnionitis/ intraamniotic infection | Endometritis | Pyelonephritis |
| Pneumonia/influenza | Pneumonia/influenza | Wound Infection/ necrotizing fasciitis |
| Pyelonephritis | Pyelonephritis | Mastitis |
| Appendicitis | Wound Infection/ necrotizing fasciitis | Cholecystitis |

Clinical quality improvement toolkits for hemorrhage and hypertension have been instrumental in driving reductions in maternal mortality and morbidity, and there are similar opportunities for improving outcomes for women who experience maternal sepsis. We have created simple and practical approaches to care that make adoption of our CMQCC toolkits much more likely to succeed. Here, we present a two-step approach for the diagnosis of sepsis that is designed to reduce false-positive and false-negative cases. In addition, we provide practical implementation aids for support bundles, antibiotic choices, and navigation through the Centers for Medicare and Medicaid Services (CMS) Sepsis-1 protocols.[10]

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1. Creanga AA, Syverson C, Seed K, et al. Pregnancy-Related Mortality in the United States, 2011-2013. Obstet Gynecol 2017 Aug;130(2):366-373.
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## In This Toolkit



# PART I.
# Screening and Diagnosis of Sepsis

## KEY PRINCIPLES:

1. Current screening systems perform poorly in pregnancy.
2. We recommend a two-step approach for the diagnosis of sepsis during pregnancy and postpartum. The first screening step is limited to vital signs adjusted for pregnancy and the most recent white blood cell (WBC) count (within 24 hours). The second diagnostic step uses evaluation for end organ injury with laboratory values adjusted for pregnancy where needed.
3. The utility of lactic acid during labor is debated. Nevertheless, women with elevated values require careful individual consideration.

# Inadequacy of Current Screening and Diagnostic Criteria

There is considerable controversy about both the definition of sepsis and what criteria to use to screen for sepsis in non-pregnant adults. In 2016, a taskforce composed of members of the Society of Critical Care Medicine and the European Society of Intensive Care Medicine produced new definitions for sepsis.[1] They recommended the use of quick Sequential Sepsis-related Organ Failure Assessment (qSOFA) (systolic BP ≤ 100 mm Hg; respiratory rate ≥ 22 breaths/min; or altered mental status) bedside scoring for sepsis screening outside of the Intensive Care Unit (ICU). A score of **two or more** identified patients who have a suspected infection and are at risk for increased mortality. They no longer recommended the use of systemic inflammatory response syndrome (SIRS) criteria for screening and classification of sepsis because SIRS focused on inflammation and did not adequately reflect the dysregulation seen in persons with sepsis. However, the new recommendations have been met with criticism. While qSOFA scoring correlates with in-hospital mortality with increased specificity, it lacks the sensitivity to detect sepsis at an early stage to allow for early intervention.[2-4] Furthermore, the Centers for Medicare and Medicaid Services (CMS) sepsis core measure continues to use the prior definition for diagnosis of sepsis (source of infection and two or more SIRS criteria) when determining payment for sepsis management.[5] Notably, studies that evaluated sepsis criteria specifically excluded pregnant women. This limits their utility for maternal sepsis given the significant vital sign changes that occur during pregnancy.

The World Health Organization (WHO) has defined maternal sepsis simply as a life-threatening condition with organ dysfunction resulting from infection during pregnancy, childbirth, post-abortion, or the postpartum period (up to 42 days).[6] Defining the criteria for sepsis and organ dysfunction during pregnancy and labor has been challenging. A recent meta-analysis of 87 studies (including 8,834 patients) examined the range of normal values during pregnancy. They found considerable overlap with SIRS criteria. Healthy pregnant women during the second trimester, third trimester, and labor often met each of the SIRS criteria except temperature.[7] In a case control study of patients with maternal sepsis, SIRS criteria had a sensitivity and specificity of 93% and 63% respectively, to correctly identify sepsis. While SIRS criteria appear to be sensitive when applied to pregnant women, they have very high rates of false-positive findings due to their low specificity.[8] As an example, in a cohort of 913 women with the most common obstetric infection, (chorioamnionitis/intraamniotic infection), 575 women (63%) met SIRS criteria, but only five were deemed to have sepsis. The same study examined the utility of screening using vital signs adjusted for pregnancy (Maternal Early Warning Scores or [MEWS]). Ninety-two women (10.3%) met criteria of MEWS with a score of ≥ 5; however, only 5 women had sepsis.[9] MEWS and SIRS score poorly in detecting sepsis.

**TABLE 2.** Performance of SIRS, Modified MEWS, and qSOFA Criteria for Diagnosing Sepsis[8]

| Criteria | Sensitivity | Specificity |
|---|---|---|
| SIRS (any two): T < 36°C or > 38°C; WBC < 4 or > 12; HR > 90; RR > 20 | 0.93 | 0.63 |
| Modified MEWS (any one): SBC < 90 mm Hg; HR > 120; RR > 30; neurological changes | 0.82 | 0.87 |
| qSOFA (any two): RR > 22; SBC < 100 mm Hg: neurological changes; RR > 22 and SBC < 100 mm HG | 0.50 | 0.95 |

In contrast to SIRS, the currently recommended qSOFA had lower sensitivity of 50% and a higher specificity of 95%.[8] The Society of Obstetric Medicine Australia and New Zealand proposed an obstetrically modified qSOFA screening tool (referred to as omqSOFA) with raised thresholds for pregnancy, thereby potentially increasing the specificity. However, given the poor sensitivity with standard qSOFA, the proposed more stringent omqSOFA would also have poor sensitivity.[8,10]

Due to the high false-positive rates for SIRS and low sensitivity for qSOFA in pregnancy, most hospitals are not formally screening for sepsis in obstetric patients as they are required to do in other patient care departments. This is concerning, as sepsis remains one of the top five etiologies of maternal mortality. Due to the concern for missing upwards of 50% of patients with maternal sepsis, we chose not to endorse the qSOFA screening tool.

# A New Two-Step Approach to Screening

The California Maternal Quality Care Collaborative (CMQCC) proposes a new two-step approach for screening of pregnant women to reduce both false-positive and false-negative cases. We take advantage of the high sensitivity of an obstetrically modified SIRS screen as a first step and then follow with the high specificity of an evaluation for end organ injury using obstetrically modified laboratory ranges.

## Step 1: Initial Sepsis Screen

Centers for Medicare and Medicaid Services (CMS) sepsis core measure and Sepsis-3 definitions of sepsis require a full evaluation for end organ injury in suspected sepsis.[1] It would be costly over-intervention to initiate the complete organ injury panel of laboratory testing and interventions for every pregnant woman with a positive standard SIRS criterion; (recall the 63% of women with chorioamnionitis/intraamniotic infection that have positive standard SIRS criteria). Therefore, we modified standard SIRS criteria to account for physiological changes of pregnancy in order to reduce false-positive cases during the initial sepsis screening. We based our approach on a recent meta-analysis of healthy pregnant women that found that two standard deviations from the mean for temperature, heart rate, and respiratory rate were 38.1°C (100.6°F), 107 beats per minute, and 25 breaths per minute, respectively. Assuming a normal distribution, patients meeting these thresholds for each criterion would occur 2.5% of the time. It would be expected that approximately 2.5% or less (since two or more criteria are required) of patients may meet the proposed screening criteria due to physiological changes of pregnancy rather than infection.[7] These criteria were rounded to ≥ 38.0°C (100.4°F), > 110 beats per minute, and > 24 breaths per minute.

**BOX 1.** Initial Sepsis Screen

| Step 1: Initial Sepsis Screen for All Patients with Suspected Infection (POSITIVE if two (2) or more criteria are met) |
|---|
| • Oral temperature < 36°C (96.8°F) or ≥ 38°C (100.4°F)<br>• Heart rate > 110 beats per minute and sustained for 15 minutes<br>• Respiratory rate > 24 breaths per minute and sustained for 15 minutes<br>• White blood cell count > 15,000/mm$^3$ or < 4,000/mm$^3$ or > 10% immature neutrophils (bands) |

## Sepsis Screening Points:

- In the setting of suspected infection, a mean arterial pressure (MAP) < 65 mm Hg is sufficient to initiate the sepsis protocol even if other sepsis screening criteria are not met.
- If an abnormal value is detected, verification of the abnormal value and a complete set of vital signs including oxygen saturation should be taken and repeated after 15 minutes.
- A screen is considered positive if two or more values meet the criteria listed in Box 1. A white blood cell count that has been obtained within 24 hours can be used for the initial screen.
- Our recommended threshold for heart rate is 110 beats per minute based on two standard deviations of normal. Other entities have recommended 120 beats per minute as a cut off for the MEWS criteria, but this may have a lower sensitivity for sepsis. Note that a sustained maternal heart rate > 130 beats per minute is especially concerning for current or future end organ injury from sepsis.
- Abnormal temperature and elevated heart rate may be the most common combination but note that not all women with sepsis will have a fever at ≥ 38.0°C (100.4°F). Therefore, if infection is suspected (e.g. costovertebral angle tenderness plus low grade temperature elevation; or prolonged rupture of membranes with maternal or fetal tachycardia), it is appropriate to proceed with further laboratory testing to rule out end organ injury and bedside assessment as discussed in Step 2, Box 2.
- Maternal corticosteroid administration often increases the white blood cell count, but the suspicion for infection should not be discounted without further evaluation. White blood cell values peak 24 hours after administration of corticosteroids for fetal lung maturity (two standard deviations from the mean is 20.8 x 10$^6$/L), and return close to baseline values by 96 hours after administration.[11]
- Screening criteria parameters should be continued through all stages of labor and continued until the patient is discharged from the hospital. Vital signs should not be taken during contractions to avoid obtaining transient aberrant values.

To detect women with impending sepsis, all members of the clinical team should maintain a high index of suspicion and embrace non-hierarchical communication. All team members should feel empowered to speak up about a concern and know that their input is valued by the care team. Effective team communication enables members to relay relevant information in a way that is clear and understood. For example, if a nurse suspects infection in a patient who screens positive for two or more modified SIRS criteria, this may be sufficient to proceed to Step 2 for further evaluation.

## Step 2: Confirmation of Sepsis

If the initial sepsis screen is positive ([two or more of the four elements from Box 1] with suspicion or evidence of infection), the next step is evaluation for end organ injury including laboratory studies listed in Box 2, and prompt bedside evaluation by a physician or other clinician with the ability to escalate care. While waiting for organ injury laboratory results, therapy should be promptly initiated (ideally within one hour) for infection with administration of antibiotics targeted for the presumed site and bolus of 1-2L intravenous fluids (IV).[12]

**BOX 2.** Confirmation of Sepsis

| Step 2: Confirmation of Sepsis Test to Evaluate End Organ Injury |
|---|
| *Laboratory values* |
| • Complete blood count (including % immature neutrophils [bands], platelets)<br>• Coagulation status (prothrombin time/international normalized ratio/partial thromboplastin time)<br>• Comprehensive metabolic panel (specifically include bilirubin, creatinine)<br>• Venous lactic acid |
| *Bedside assessment* |
| • Urine output (place Foley catheter with urometer)<br>• Pulse oximetry<br>• Mental status assessment |

*See Table 3 for Criteria for End Organ Injury*

## Case Study:

Sarah, a 24-year old primara was hospitalized for preterm rupture of membranes at 32 weeks of gestation. On the eighth day of hospitalization, Sarah reported "feeling warm" and her heart was "racing." Her vital signs included: Temp 36.6°C (97.8°F), HR 130/min, Resp 22/min, BP 115/62 mm Hg, oxygen saturation 98% room air, FHR 160/min. She began contracting every three minutes with a cervical exam of 3/80/-1. No foul-smelling drainage noted. WBC was being collected daily and was now noted to be 22,000/mm$^3$. Although the patient had a positive screen for sepsis, no confirmatory testing was performed because Sarah did not have a fever and there was "no clear source" of infection. The rising WBC was discounted as Sarah received betamethasone four days prior. Two hours following the screen for sepsis, the patient was still contracting and looked uncomfortable. The fetal heart rate tracing indicated minimal variability with occasional late decelerations. The patient was repositioned, fluid bolus administered, and oxygen was delivered at 10L/min via facemask. The decision was made to perform a repeat cesarean section immediately. Apgar scores were 1 and 8. In the recovery room, the patient developed chills and a temperature of 38.8°C (101.8°F),HR of 120/min, and BP of 88/40 (MAP 56) mm Hg. She also felt short of breath with respirations of 36/min. Oxygen was applied at 3L/min via nasal prongs. The intensivist and rapid response nurse were called to the bedside to evaluate for septic shock. Intravenous fluids at 30 mL/kg were administered. Sepsis end organ injury labs and blood cultures were sent. Piperacillin/tazobactam (Zosyn) was administered intravenously for the unknown source of infection. The lactate level was reported 30 minutes later at 9 mmol/L; the urine output was 10 mL/hour, and the patient was bleeding at the incision site. Following team consultation, which included a full rapid response team and intensivist, the patient was transferred to the ICU. The patient remained hypotensive (BP 88/44 mm Hg) and received a second fluid bolus of two liters. She eventually stabilized with continued broad-spectrum antibiotics and close monitoring, and was discharged home at six days postpartum. The blood cultures grew both Group B streptococcus and E. coli. Final diagnosis: Septic shock secondary to chorioamnionitis following prolonged preterm rupture of membranes.

## Lessons Learned:

Even though she did not have a fever, Sarah met initial screening criteria for sepsis–any two criteria positive (in her

case, heart rate and WBC) with suspicion of infection. A key lesson is that fever does not need to be present for patient to have an infection. Sarah displayed multiple indicators for an infection including prolonged preterm rupture of membranes, contractions, feeling warm, increased WBC, and maternal and fetal tachycardia. A maternal heart rate of 130/min is particularly noteworthy. With the lack of sepsis confirmation testing, there were missed opportunities to perform earlier delivery and earlier treatment with fluids and antibiotics that could have avoided progression to septic shock. This case illustrates the common mistake of minimalizing signs and symptoms in our young healthy maternity patients and discounting important signals: "there is no fever, therefore she is not infected"; "the WBC elevation is because of the betamethasone"; "130/min HR is related to labor", etc. Of note, per our CMQCC algorithm, we recommend prompt initiation of fluids and antibiotics after a positive sepsis screen with suspected infection, even before the sepsis confirmation testing is complete.

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We aligned the diagnostic criteria for end organ injury and therefore the diagnosis of sepsis with the CMS sepsis core measure wherever possible, as outlined in the measure specifications.[5] CMQCC adjusted several criteria for pregnancy when supported by clinical data and the revised criteria are noted in Table 3. (See Appendix A for side-by-side comparison of End Organ Injury Criteria among CMS Sepsis-1, CMQCC Sepsis Toolkit, and Sepsis-3 SOFA score.) A discussion of the data to support the CMQCC adjustments (Appendices B and C) follows the table.

**TABLE 3.** Criteria for End Organ Injury for Diagnosis of Maternal Sepsis **(only one criterion is sufficient for diagnosis)**

| Measure of End Organ Injury | Criteria (one criterion is sufficient for diagnosis) |
|---|---|
| Respiratory function | • Acute respiratory failure as evidenced by acute need for invasive or non-invasive mechanical ventilation, OR<br>• $PaO_2/FiO_2 < 300$ |
| Coagulation status | • Platelets < 100 x $10^9$/L, OR<br>• International Normalized ratio (INR) > 1.5, OR<br>• Partial Thromboplastin Time (PTT) > 60 seconds |
| Liver function | • Bilirubin > 2 mg/dL |
| Cardiovascular function | • Persistent hypotension after fluid administration:<br>◦ SBP < 85 mm Hg, OR<br>◦ MAP < 65 mm Hg, OR<br>◦ > 40 mm Hg decrease in SBP |
| Renal function | • Creatinine > 1.2 mg/dL, OR<br>• Doubling of creatinine, OR<br>• Urine output < 0.5 mL/kg/hour (for 2 hours) |
| Mental status assessment | • Agitation, confusion, or unresponsiveness |
| Lactic acid | • 2 mmol/L in the absence of labor (Lactic acid is not used for diagnosis in labor, but remains important for treatment. Please see discussion.) |

$PaO_2$ = Partial pressure of oxygen in the alveoli; $FiO_2$ = Fraction of inspired oxygen; SBP = systolic blood pressure; MAP = mean arterial pressure; End organs are the same as for Sepsis-3[1]

## Advantage of a Two-Step Approach for Sepsis

Patients who meet two or more criteria of the initial sepsis screen (Step 1) and also meet one or more end organ injury criteria (Step 2) receive a diagnosis of sepsis. The two-step process allows for increased sensitivity resulting in fewer missed sepsis cases and also increased specificity resulting in fewer false-positive cases. This is similar to testing for syphilis, where venereal disease research laboratory (VDRL) test is used as a screening tool followed by the much more specific Treponema pallidum particle agglutination (TPPA) assay as the diagnostic test. Other groups that have struggled with diagnostic criteria for maternal sepsis have suggested a similar approach.[13] This tactic has been in routine use in the obstetric units of three major health care systems in California: Dignity Health, Sutter Health, and Kaiser-Permanente. Their experience has confirmed that approximately 2% of patients will screen positive, and these women are then followed with a second step (end organ injury evaluation) to confirm the diagnosis. In our clinical experience, this system rarely fails to identify patients with sepsis defined by end organ injury.

Based on the evaluation of the two-step system as shown in Table 4 below, the approximate sensitivity is 32/33 = 97%. TP/(TP +FN); the approximate specificity is 14,552/ (14,552 + 166) = 99% TN/(TN+FP).

**TABLE 4.** Performance of a Two-Step System for Diagnosis of Maternal Sepsis
(data extracted from clinical practice data sets, not formal research studies)

| System | Obstetric Vital Signs Screen | | Sepsis (End Organ Injury) | | |
|---|---|---|---|---|---|
| | *Population Screened* | *Screen Positive* | *Total with End Organ Injury* | *Among Screen Positive* | *Not Among Screen Positive* |
| Dignity Health* (Intrapartum) | 13,015 | 166 (1.3%) | 20 (10.5% of screen positives) (0.15% of all screened) | 19 (95%) | 1 (5%) |
| Sutter Health** (Intrapartum) | 525 | 10 (1.9%) | 1 (20% of screen positives) (0.46% of all screened) | 1 (100%) | 0 (0%) |
| Sutter Health** (Antepartum) | 576 | 11 (1.9%) | 4 (36.4% of screen positives) (0.46% of all screened) | 4 (100%) | 0 (0%) |
| Sutter Health** (Postpartum) | 636 | 12 (1.9%) | 8*** (66.6% of screen positives) (1.9% of all screened) | 8 (100%) | 0 (0%) |
| Combined Population | 14,752 | 199 (1.3%) | 33 (16.6% of screen positives) (0.22% of all screened) | 32 (97%) | 1 (3%) |

****5 of the 8 were identified by elevated lactate and 3 by oliguria*

*Dignity screen: Temp ≥ 38°C, HR > 110, RR > 24, two of these three criteria (Note: in the setting of suspected infection, if MAP < 65 mm Hg and confirmed, then the diagnosis of septic shock was made). Confirmation of sepsis was made using end organ injury criteria.
*Dignity Health data: Courtesy of Larry Shields, MD (using MEWS surveillance system, built into electronic health records)*

**Sutter screen: Temp ≥ 38°C, HR > 110, RR > 24, WBC > 15k, two of these four criteria (Note: in the setting of suspected infection, if MAP < 65 mm Hg and confirmed, then the diagnosis of septic shock was made). Confirmation of sepsis was made using end organ injury criteria.
*Sutter Health data: Courtesy of Lori Olvera, DNP (from OB Sepsis QI project, chart reviews)*

**BOX 3.** Evaluation of Two-Step System

Approximate Sensitivity: 32/33 = 97%. TP/(TP+FN)
Approximate Specificity: 14,552/ (14,552 + 166) = 99%. TN/(TN+FP)

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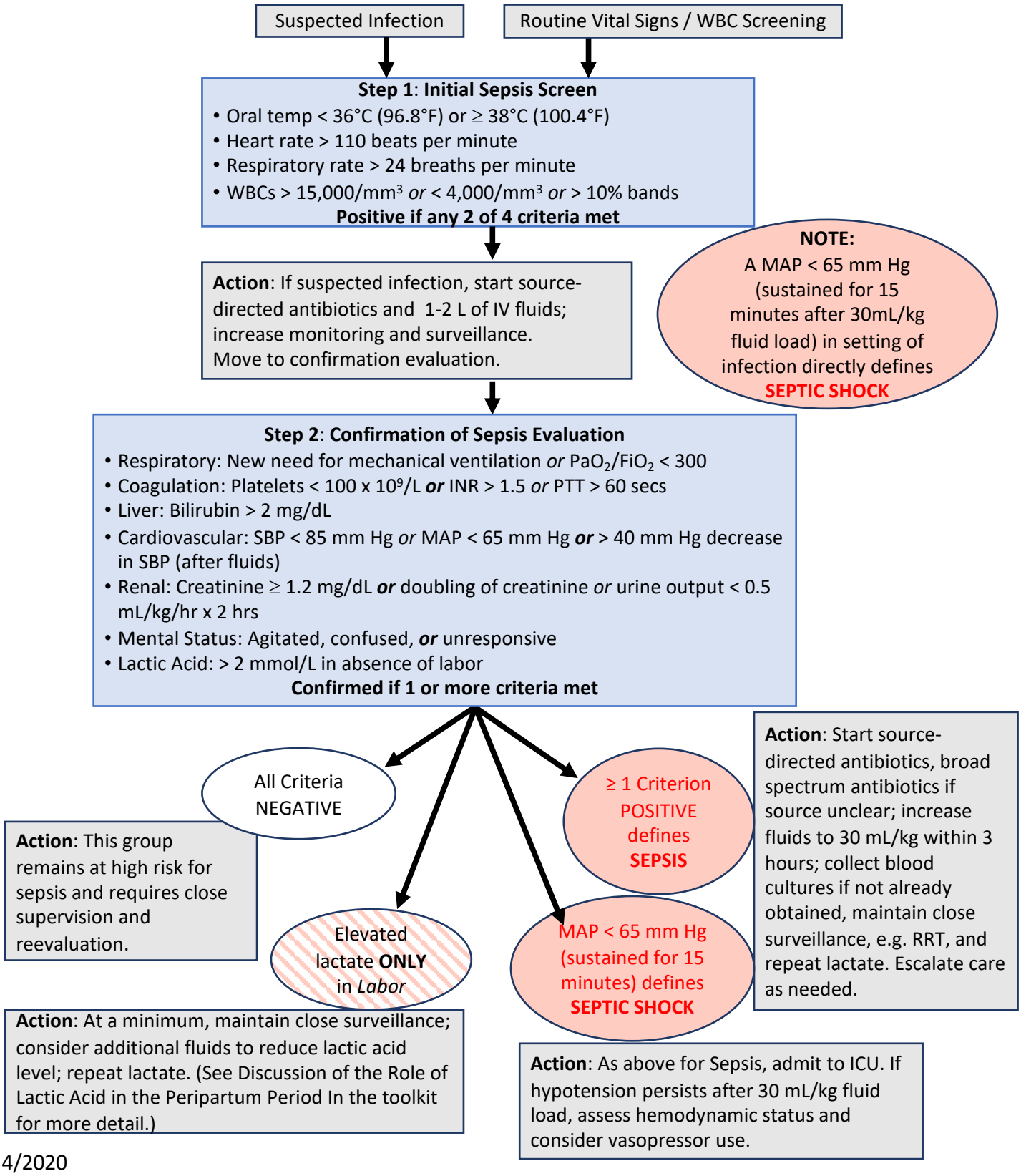
Figure 1 and Appendix D can be used to guide bedside care. All such algorithms need local review and subsequent modifications to meet specific local issues.

**FIGURE 1.** Maternal Sepsis Evaluation Flow Chart



## Discussion of the Role of Lactic Acid in the Peripartum Period

The CMQCC Sepsis Taskforce had the most difficulty forging consensus regarding the utility of lactic acid in the evaluation of infections in the intrapartum period. Even outside of pregnancy the correct role for lactic acid in the diagnosis of sepsis is being reevaluated. The Sepsis-3 consensus experts did not agree with prior panels for use of lactic acid in establishing the diagnosis of sepsis and recommended against the use of lactic acid for screening concurrent with qSOFA screening.[1] Furthermore, pregnancy complicates the interpretation of lactic acid levels. Labor can be associated with high levels of lactic acid in the absence of serious infection, likely due to anaerobic metabolism during prolonged physical exertion. When not in labor, lactic acid levels in pregnant women are similar to non-pregnant women. In those settings, the same lactic acid value thresholds can be used with expected values less than 2 mmol/L.[14] A meta-analysis of 22 studies of normal healthy pregnant women without infection demonstrated a rise in the average level of lactic acid during labor with an increasing portion of cases above 2.0 mmol/L. Most importantly, these data were from women without infection and illustrate the limited utility of lactic acid for screening for sepsis in this population.[14]

Conversely, for pregnant women with infection, high lactic acid levels are concerning. In a cohort of pregnant women with suspected infection presenting to the emergency room, elevated levels of lactic acid were associated with higher morbidity (ICU admission, telemetry, length of stay, and positive blood cultures).[15] Also, in a study of 100 pregnant women with infection, a lactic acid level ≥ 4mmol/L had a sensitivity and specificity to identify sepsis of 38% and 88%, respectively.[16] Lactic acid can also be considered an important criterion to follow for adequate treatment of hypoperfusion in patients with sepsis (as suggested by the Surviving Sepsis Campaign).[12]

In summary, in pregnant women with a positive initial sepsis screen and suspected infection who are not in labor, a lactic acid level > 2 mmol/L confirms a diagnosis of sepsis per CMS criteria. As noted above, lactic acid levels may increase during labor as a result of anaerobic metabolism.[17-19] However, we have limited data to make strong recommendations for the interpretation of elevated lactic acid for women in labor **with suspected infection**. Therefore, for women in labor with a positive initial sepsis screen, but negative confirmation of sepsis (lacking criteria for end organ injury) who have an elevated lactic acid level, we recommend close surveillance, repeated bedside evaluation for additional fluids, and repeating evaluation of lactic acid over time.

There are special considerations for the blood draw technique to obtain a valid lactic acid result. Inaccurate lactic acid results may occur as a result of a difficult blood draw, prolonged tourniquet time, or prolonged transport times to the laboratory. These issues can cause an elevated lactic acid level in the specimen. As a result, a woman might unnecessarily receive escalation of care.

For lab testing, a gray-top tube or a venous/arterial blood gas syringe should be used. Hemolysis during the blood draw can raise lactic acid levels proportionally and techniques to minimize hemolysis during specimen collection should be utilized. A recent same-subject controlled study did not show a relationship with routine tourniquet use; still, it is generally recommended that the lactic acid sample should be first in a multiple vial collection, placed immediately on ice, delivered quickly to the laboratory, and the analysis should be performed within 20-30 minutes for the most accurate results.[20]

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## In This Toolkit



# PART II.
# Assessment and Treatment of Maternal Sepsis: Care Bundles

## KEY PRINCIPLES:

The Surviving Sepsis Campaign recommends the following:

1. Act quickly upon recognition of sepsis and septic shock.
2. Minimize time to treatment. Sepsis is a medical emergency.
3. Monitor closely for response or lack of response to interventions.
4. Communicate sepsis status during bedside care and handoff.

**TABLE 5.** Assessment and Monitoring Recommendations Following a Positive Step 1 Initial Sepsis Screen
The ongoing assessment recommendations are based on 'Time Zero'. Once the patient triggers a positive initial sepsis screen, 'Time Zero' will start.

| Monitoring | Time Frame | Additional Considerations |
|---|---|---|
| Fetal monitoring | Continuous | Antepartum/intrapartum |
| Pulse oximetry | Continuous | Until vital signs are normalized |
| Blood pressure (MAP) | Q 30 minutes from 'Time Zero' | Until lactate less than 2.0 mmol/L, then Q2 h for non-laboring patients* |
| Temperature | Q 30 minutes from 'Time Zero' | Until lactate less than 2.0 mmol/L, then Q2 h for non-laboring patients* |
| Urine output | Q 1 hour from 'Time Zero' | Foley catheter with urometer |
| Mental status | Continuous | Note agitation, confusion, or unresponsiveness |

**Jones, AE. Lactate Clearance for Assessing Response to Resuscitation in Severe Sepsis. Acad Emerg Med 2013 Aug;20(8):844-847*
*A review of nursing technique for collecting a urine sample from a Foley catheter is provided in Appendix E.*

## Cultures

Blood cultures are not required for women with uncomplicated infections, but all guidelines for sepsis recommend blood cultures and other site cultures as appropriate. Blood cultures should be collected prior to antibiotic administration when possible. Society of Critical Care Medicine recommends appropriate routine microbiologic cultures be obtained prior to starting antimicrobial therapy in patients with suspected sepsis and septic shock if it does not result in substantial delay in the start of antimicrobials.

We recommend that blood cultures be drawn when sepsis is confirmed (see Maternal Sepsis Evaluation Flow Chart) even if antibiotic therapy has been initiated.

For chorioamnionitis/intraamniotic infection and endometritis, lower genital tract cultures are rarely performed because they may reflect primarily contaminating organisms. Furthermore, patients initially diagnosed with chorioamnionitis/endometritis generally have negative blood cultures, or a positive culture is reported after a recovered patient has been discharged. Should the patient show signs of end organ injury or septic shock, however, blood cultures should be obtained if not already done. In order to optimize identification of causative organisms, at least two sets of cultures for anaerobes and aerobes should be collected.[1] If the same organism is identified in both sets of blood cultures, the likelihood that the organism is causing sepsis is increased.[2]

Blood cultures should be drawn within three hours following a diagnosis of sepsis with organ dysfunction per CMS guidelines (Hospital IQR Guidelines) V 5.5.[3] According to CMS guidelines, it is acceptable to draw blood cultures if antibiotics were commenced in the previous 24 hours before sepsis was identified. In addition, if there is concern for a patient's deteriorating condition due to rapidly advancing infection, antibiotics should be started immediately with documentation that blood cultures will be drawn as soon as possible.

## Fluid Management

Patients with sepsis or septic shock have low circulating intravascular volume. It is vital to optimize circulating volume and improve cardiac output (blood pressure) and tissue perfusion. We recommend that resuscitation from sepsis-induced hypoperfusion include at least 30 mL/kg of intravenous crystalloid fluid within three hours of recognition of sepsis.[4] Surviving Sepsis Campaign does not recommend one crystalloid over another.

Surviving Sepsis Campaign (2018) recommends that following initial fluid resuscitation, additional fluids administration should be guided by frequent reassessment of hemodynamic status.[4] The most common approach is to use a non-invasive cardiac output monitor that measures stroke volume and cardiac output in response to a fluid challenge, either from a 250 mL fluid bolus or from passive leg raising. It should be noted that passive leg raising is contraindicated due to vena cava pressure unless a uterine displacement is performed. The use of non-invasive continuous cardiac output monitoring has been validated in the obstetric population.[5-6] A Rapid Response Team (RRT) nurse, ICU nurse, or emergency room nurse may perform a non-invasive cardiac monitor perfusion assessment. The nurse will record the stroke volume index (SVI) baseline, SVI challenge and SVI percentage change. If the SVI percentage change is greater than 10, the patient is fluid responsive. If SVI percentage change is less than 10, then additional fluids are not required. The use of non-invasive monitoring is also beneficial in patients with preeclampsia or an existing cardiac condition where there is concern for administrating large fluid boluses. It is important to determine if your facility has a non-invasive cardiac monitor and, if so, who performs the test. Usually this will be accomplished in conjunction with an intensivist who is co-managing the patient. When dynamic measurement systems are not available, tissue perfusion can be assessed after aggressive fluid resuscitation including blood pressure and heart rate response, urine output, transthoracic echocardiogram, central venous pressure (CVP), or central venous oxygen saturation ($ScvO_2$) measurement, pulse pressure variation, and lactate clearance/normalization.[7] Tissue perfusion assessment must be performed by a physician, physician's assistant, or nurse practitioner.

Care of maternal sepsis requires a multidisciplinary team. Table 6 provides special recommendations that are specific to pregnancy that can easily be overlooked in the ICU setting.[8,7]

**TABLE 6.** Additional Considerations for Pregnant Women with Sepsis

| Consideration | Comment |
|---|---|
| Vasopressors | Norepinephrine is recommended in pregnancy and used if MAP < 65 mm Hg if unresponsive to intravenous fluids. |
| Inotrope | Dobutamine is recommended for myocardial dysfunction or hypoperfusion despite intravenous fluids and vasopressors as it increases cardiac output. |
| Glucose control | Avoid hyperglycemia > 180 mg/dl. |
| Maternal temperature control | Reduce fetal oxygen consumption and fetal tachycardia using acetaminophen and cooling blankets. |
| Fetal lung maturity | Consider steroids for fetal lung maturity if 23-36* weeks of pregnancy. |
| DVT prophylaxis | Lower leg sequential compression devices while on bed rest. |

**Gymafi-Bannerman C, Thom EA, Blackwell SC et al. Antenatal Betamethasone For Women at Risk for Late Preterm Delivery. N Eng J Med 2016 Apr;374:1311-1320*

## Communication and Teamwork Tools

A critical aspect of care for a patient with sepsis is clear and direct communication. Effective communication techniques will enhance perinatal patient outcomes. With any new practice, there may be resistance to establishing a treatment plan for early recognition of maternal sepsis. Clear communication that is firm and respectful can provide a culture of safety. We provide a review of communication techniques in Appendix H, examples of a sepsis debriefing tool (Appendix I), and scenario for a sepsis drill (Appendix J).

## Rapid Response Team and Escalation of Care Coordination

Most hospitals have a RRT that is important for supporting patients with sepsis and septic shock. Typically, the RRT is comprised of a critical care nurse and a respiratory therapist. The RRT supports the care team outside of the emergency and intensive care departments and is particularly useful in obstetric units where critically ill patients are uncommon. The RRT can assist with assessment of a deteriorating patient, provide early intervention, and make recommendations for lab tests and treatment.

Clinically unstable obstetric patients (pregnant or postpartum) at risk for rapid deterioration are usually transferred to a higher level of care. Because obstetric patients with sepsis are younger, usually with fewer co-morbidities, and are generally healthier as compared to the overall population, these patients tend to withstand the challenges of sepsis for a longer time period but can then rapidly deteriorate.[9] Maternal physiologic changes such as an elevated heart rate and lower blood pressure can mask some of the signs of clinical deterioration. The decision to transfer an obstetric patient to a higher level of care should be made by a multidisciplinary team, including the obstetrician, anesthesiologist, nurse, the ICU critical care physician (and if appropriate, the neonatologist/pediatrician). Because facilities may have different resources in their obstetric units for the support of a patient with sepsis, decisions such as a transfer to ICU should be based on the capabilities of each facility.

If the transfer to higher level of care necessitates transfer to a different hospital, the woman must be stabilized prior to transport. If delivery is imminent, it may be safer to 'shelter in place' and transfer after delivery. Safe transport of a critically ill pregnant or postpartum patient to a different hospital requires continuous cardiac monitoring, pulse oximetry, venous access, and assessment of vital signs. The recommendation is not to delay transport of a critically ill pregnant woman because of inability to monitor the fetus; stabilizing the mother will stabilize the fetus.

If the transfer of a pregnant or postpartum patient occurs within the hospital, it is important that the patient is accompanied by the appropriate team members, which may include the obstetrician, anesthesiologist, and nurse, as well as the equipment necessary for monitoring the mother and fetus. Decisions for fetal monitoring can be individualized based on the mother's condition.[10,8] For pregnant women, the timing and mode of delivery should be planned, communicated to all team members, and continuously updated and reviewed in team meetings.

**BOX 4.** Criteria for Consideration of Transfer to a Higher Level of Care

| Criteria Considerations |
|---|
| • Hypotension (MAP < 65mm Hg) despite fluid resuscitation or need for administration of vasopressors<br>• Persistent hypoxia ($SpO_2$ < 92% on room air)<br>• Altered mental status (combativeness, confusion, disorientation) |

In these circumstances, assessment and communication among essential personnel should include specialists in critical care, obstetrics and/or maternal-fetal medicine, anesthesiology, as well as nursing coverage for peripartum and ICU care. Preparation for birth, either vaginal or cesarean, should be taken into consideration inclusive of need for equipment for delivery, neonatal resuscitation and/or postpartum needs (e.g. breast pump set up).

**TABLE 7.** Patient Location and Team Management

| Location | ICU for Antepartum Patient | Labor and Delivery | ICU for Postpartum Patient |
|---|---|---|---|
| Team | • Critical care physician (with MFM/OB consult)<br>• Anesthesiologist<br>• L&D/antepartum RN to assess for labor signs and perform fetal monitoring<br>• NICU staff on stand-by | • MFM/OB with critical care consult<br>• Anesthesiologist<br>•ICU RN for invasive monitoring<br>•NICU staff on stand-by | • Critical care physician (with OB/MFM consult)<br>• Postpartum RN to perform postpartum assessments |
| Preparations | • Vaginal delivery and emergent cesarean section equipment in the ICU<br>• Neonatal resuscitation equipment in the ICU | • Vaginal delivery and emergent cesarean section equipment in the ICU<br>• Neonatal resuscitation equipment in the ICU | • Breast pump set up<br>• Newborn bonding, pictures, visits to ICU, skin-to-skin<br>• Psycho-social support for the woman and her family |

## Distinguishing Chorioamnionitis/ Intraamniotic Infection from Sepsis

As noted in the introduction (Table 1), chorioamnionitis/intraamniotic infection is a leading cause of maternal sepsis. Chorioamnionitis/intraamniotic infection is common, developing in approximately 4% of labors.[11] Approximately 20% to 25% of cases of maternal sepsis may be attributable to chorioamnionitis/intraamniotic infection.[12] Here, we emphasize the diagnostic criteria for chorioamnionitis/intraamniotic infection and the distinguishing criteria between this infection and sepsis. In 2017, The American College of Obstetricians and Gynecologists recommended the following categorization: isolated maternal fever, suspected intraamniotic infection, and confirmed intraamniotic infection.[12] This ACOG document noted that intraamniotic infection is also known as "chorioamnionitis." We present the ACOG categorization scheme side-by-side with the CMQCC criteria for identification of sepsis, to help illustrate the differences between these conditions (Table 8).

**TABLE 8.** Criteria to Recognize Intraamniotic Infection and Sepsis

| Isolated Maternal Fever | Suspected Intraamniotic Infection | Confirmed Intraamniotic Infection | CMQCC Criteria for Sepsis (Two-Step Approach: Initial Screen Positive Plus End Organ Injury) |
|---|---|---|---|
| A single oral temperature of 39.0°C (102.2°F) or greater<br>**OR**<br>Oral temperature of 38.0-38.9°C (100.4-102.02°F) that persists when the temperature is repeated after 30 minutes | Maternal fever of ≥ 39.0°C (102.2°F) OR 38-38.9°C (100.4-102.02°F), *plus one additional clinical risk factor:*<br>• Maternal leukocytosis<br>• Purulent cervical drainage<br>• Fetal tachycardia | Positive amniotic fluid test result (gram stain, glucose level, or culture results consistent with infection)<br>**OR**<br>Placental pathology with histologic evidence of infection or inflammation | *2 of the following:*<br>• Temp ≥ 38.0°C (100.4°F)<br>• Pulse > 110<br>• Respiratory rate > 24<br>• WBC > 15,000<br>*PLUS evidence of end organ injury:*<br>• Respiratory<br>• Coagulation<br>• Liver<br>• Cardiovascular<br>• Renal<br>• Mental status |

The diagnostic challenge arises from the fact that maternal sepsis often does not present with the symptoms typically present in the non-obstetric population. Fever may not be present at diagnosis and may never develop.[13] With labor, there can be an increase in lactic acid in the second stage in the absence of infection.[14] Differentiating uncomplicated chorioamnionitis/intraamniotic infection from sepsis may be more challenging. A woman with chorioamnionitis/intraamniotic infection may be febrile and tachycardic due to infection, may have an elevated lactic acid level from labor, but not have the criteria for organ dysfunction (hence, diagnosis of sepsis). Fortunately, the initial steps for treatment of chorioamnionitis/intraamniotic infection and sepsis are similar (i.e. initiation of broad spectrum antibiotics and adequate fluid resuscitation).[8] With improvements in the recognition of the source of maternal fever, appropriate treatment will be easier to implement.

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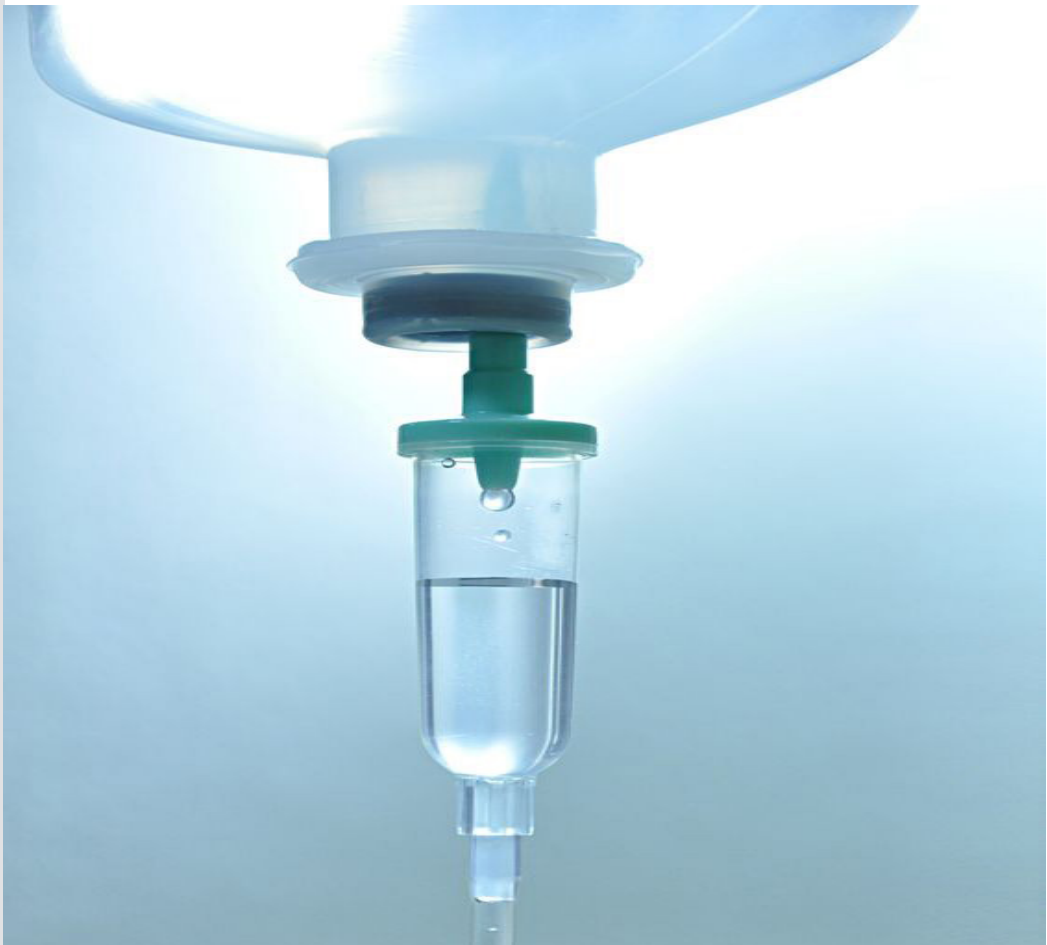
## In This Toolkit



# PART III.
# Assessment and Treatment of Maternal Sepsis: Antibiotics and Source Control

## KEY PRINCIPLES:

1. Early administration of antibiotics, ideally within one hour of presentation, is critically important in sepsis.
2. The initial choice of antibiotics in critically ill patients is generally empiric and broad spectrum to cover most or all likely pathogens.
3. Assessment for source control (such as surgical/percutaneous drainage or debridement) should be initiated in a timely fashion and using the least invasive approach possible.



Antibiotics should ideally be administered within one hour of diagnosis of maternal sepsis. Initial antibiotic coverage for patients with sepsis should be empiric with use of a broad-spectrum antibiotic regimen. In the 48-72 hours following initial antibiotic administration, it is often recommended that the antibiotic regimen be narrowed as culture information becomes available and the patient stabilizes. In contrast to pyelonephritis or pneumonia, which are usually caused by a single organism, it is important to recognize that many pelvic infections are polymicrobial, involving aerobes (which are usually identified in the laboratory within 24-72 hours) and anaerobes (which may be difficult to culture and take several more days to identify in most clinical microbiology laboratories). In addition, an organism isolated from blood such as Group A *Streptococcus or E. coli* may reflect only part of the polymicrobial flora causing many pelvic infections. Furthermore, cultures from the genital site may not have been collected or tested for anaerobes. Decisions about narrowing the antibiotic regimen should therefore take into account these special considerations regarding pelvic infections.

Empiric antibiotic choices should be guided by the local antibiogram (a document produced by microbiology laboratories that lists the percentages of specific bacterial isolates tested at that lab that are sensitive to an array of antibiotics). In general, patients who have recently been hospitalized, or who have been recently exposed to antibiotics are at risk of being infected with multi-drug resistant organisms (MDRO) such as methicillin-resistant Staphylococcus aureus (MRSA) and extended spectrum beta-lactamase producing (ESBL) organisms. In patients at high risk, it is important to choose broad spectrum agents that are active against these pathogens, (e.g. vancomycin and a carbapenem). Of note, the carbapenem ertapenem does not cover *Pseudomonas* species.

In order to initiate antibiotics for women with sepsis as quickly as possible, we recommend having a sepsis order set available to clinicians (See Appendix M). Because having the antibiotics in the order set available on the unit for immediate release is important, the pharmacy should play a key role in setting up systems for rapid appropriate delivery of antibiotics in sepsis.

Pain medications such as ibuprofen and acetaminophen can mask a fever, and fever can be the result of multiple non-infectious causes (for example venous thromboembolic disease and atelectasis). Therefore, fever should not be used as a sole criterion for deciding to administer antibiotics.

Plus, as discussed in other sections, obstetric patients with sepsis may not present with fever. To review, an initial sepsis screen is considered positive if two or more criteria from Box 1 are met.

## Group A Streptococcus (GAS) Infections

Here, we wish to emphasize the importance of Group A Streptococcus (GAS) (*Streptococcus pyogenes*), which is an organism commonly responsible for fatal maternal sepsis. Group A Streptococcus can cause a range of infections from endomyometritis to fulminant endomyonecrosis, to necrotizing fasciitis and to Streptococcal toxic shock syndrome. While not all pregnant or postpartum patients with severe invasive GAS infection will develop toxic shock syndrome, it is important to be aware of this syndrome because the recommended antimicrobial regimen is different from that for sepsis due to other sources. Box 5 lists the clinical criteria for Streptococcal toxic shock syndrome.

**BOX 5.** Clinical Criteria for Streptococcal Toxic Shock Syndrome in Adults

| Clinical criteria for streptococcal toxic shock syndrome in adults |
|---|
| • Hypotension |
| • Multiorgan involvement characterized by two or more of the following:<br>- Renal impairment – creatinine ≥ 2mg/dL or in patients with pre-existing renal disease ≥ 2 times elevation above baseline<br>- Coagulopathy – Platelets ≤ 100,000/mm $^3$ or disseminated intravascular coagulation, defined by prolonged clotting times, low fibrinogen level, and the presence of fibrin degradation products<br>- Liver involvement – Alanine aminotransferase, aspartate aminotransferase, or total bilirubin levels ≥ 2 times the upper limit of normal or patients with pre-existing liver disease, ≥ 2 times elevation over baseline<br>- Acute respiratory distress syndrome<br>- Erythematous macular rash, may desquamate<br>- Soft tissue necrosis (e.g., necrotizing fasciitis, myositis, or gangrene) |

A patient who meets the clinical criteria with isolation of GAS from a normally sterile site (e.g., blood or surgical site) has a **confirmed diagnosis** of Streptococcal toxic shock syndrome. A **probable diagnosis** of toxic shock syndrome may be made for patients who meet the clinical criteria (in the absence of another explanation for the illness) with isolation of GAS from a nonsterile site (e.g. throat, or vagina).

The differential diagnosis of pregnancy-related GAS infection includes infection due to *C. perfringens* and *Clostridium sordellii* which are also associated with high morbidity and mortality. Antibiotic therapy for severe GAS

infections and Streptococcal toxic shock syndrome includes combination therapy with high dose penicillin and clindamycin. If a patient is allergic to penicillin, she should receive vancomycin (or daptomycin) plus clindamycin. Early surgical intervention (wound debridement, vulvar debridement, hysterectomy or a combination of these) for source control is critically important for necrotizing fasciitis. Cultures should be obtained at the time of debridement.

Diagnose necrotizing fasciitis clinically in the presence of fever, pain out of proportion to exam, crepitus, bullae, erythema, and rapid progression of findings. Prompt surgical management (with tissue pathology) confirms the diagnosis. Early debridement is critical.

**TABLE 9.** Proposed Empiric Antibiotic Coverage for Patients with Sepsis of Unknown Source (with End Organ Injury) or Septic Shock

| **Antibiotic Choices**<br>*Empiric coverage for sepsis of unknown source or for septic shock should include at least one antibiotic for Gram-negative and anaerobic coverage **PLUS** one for Gram-positive coverage* | **Duration** |
|---|---|
| **Gram-negative plus anaerobic coverage**<br>Piperacillin/tazobactam 3.375 g IV q8h (extended infusion) or 4.5 g IV q6h<br>**OR**<br>Meropenem 1 g IV q8h (if recent hospitalization or concern for MDRO organisms)<br>**OR**<br>Cefepime 1-2g IV q8h plus metronidazole 500 mg IV q8h<br>**OR**<br>Aztreonam 2 g IV q8h (for women with severe penicillin allergy)<br>Plus metronidazole 500 mg IV q8h<br>**OR**<br>Aztreonam 2g IV q8h plus clindamycin 900 mg IV q8h<br>**PLUS**<br>**Gram-positive coverage**<br>Vancomycin 15-20 mg/kg q8h-q12h (goal trough 15-20 mcg/mL)<br>**OR**<br>Linezolid 600 mg IV/PO q12h (for women with severe vancomycin allergy) | 7-10 days is adequate for most infections |

## Notes:

1. For patients who have had a recent hospitalization or are known to be colonized with MDRO, vancomycin + meropenem can be chosen.
2. When using vancomycin, consider a loading dose of 25-30 mg/kg in critically ill patients.
3. For patients unable to tolerate vancomycin or linezolid, consider daptomycin 8-10 mg/kg for gram-positive coverage. ***Note daptomycin is not acceptable for treatment of pneumonia.***
4. For patients at high risk of Candidemia infection (e.g. on total parenteral nutrition, has central venous catheter, or received recent broad spectrum antibiotics), add empiric echinocandin such as caspofungin 70 mg IV x1 followed by 50 mg IV daily.
5. Patients with sepsis may be too ill for concern about drug safety in breastfeeding to be a priority. Appendix L provides a summary of antibiotics with their safety recommendations for use during breastfeeding.
6. Severe allergies to beta-lactams are defined as anaphylaxis, angioedema, bronchospasm or hives within 60 minutes of a dose, or a penicillin-induced Stevens Johnson Syndrome or Toxic Epidermal Necrolysis. Without one of these complications from a penicillin, the risk of an allergic reaction to a cephalosporin is approximately 1:1000.
7. Doses recommended in this table are based on normal renal function.

**TABLE 10.** Proposed Antibiotic Dosing and Duration for Sepsis and Specific Infectious Conditions
These are general recommendations; institutional recommendations may vary based on local antibiograms. (Appendix L summarizes use of these antibiotics and their safety information during breastfeeding.)

| Condition | Antibiotic Choices | Duration | Notes |
|---|---|---|---|
| Chorioamnionitis/intraamniotic infection (Plante, et al 2019, ACOG, Castor, 2008) | Ampicillin 2 g IV q6h<br>**PLUS**<br>Gentamicin 2 mg/kg IV load, then 5 mg/kg every 24h<br>_____<br>Alternate regimens:<br>(Based on local antibiotic resistance patterns)<br><br>Ampicillin-sulbactam 3 g IV q6h<br>**OR**<br>Piperacillin-tazobactam 3.375 g IV q6h<br>**OR**<br>Cefoxitin 2 g IV q8h<br>**OR**<br>Ertapenem 1 g IV q24h | Use is generally limited to the peripartum period.<br><br>Duration of therapy is unclear, but there are some recommendations to continue until patient is afebrile for 24h. | For post-cesarean delivery: One additional dose of the chosen regimen is indicated. Add clindamycin 900 mg IV or metronidazole 500 mg IV for at least one additional dose.<br><br>For post-vaginal delivery: No additional antibiotic doses are required. If additional doses of antibiotics are given, clindamycin is not indicated.<br><br>If prior colonization or infection with MDRO, use a carbapenem (such as ertapenem).<br><br>Cefoxitin has less activity against Group B Streptococci than cefazolin, penicillin, ampicillin or vancomycin. |
| Chorioamnionitis/intraamniotic infection (penicillin allergy) | Mild penicillin allergy:<br>Cefazolin 2 g IV q8h<br>**PLUS**<br>Gentamicin 2 mg/kg IV load, then 5 mg/kg every 24h<br><br>For severe penicillin allergy:<br>Clindamycin 900 mg IV q8h<br>**OR**<br>Vancomycin – per institution protocol, goal trough 15-20<br>**PLUS**<br>Gentamicin 5 mg/kg every 24h | | |
| Endomyometritis (Plante et al 2019, ACOG) | Clindamycin 900 mg IV q8h (or metronidazole 500 mg IV q8h)<br>**PLUS**<br>Gentamicin 5 mg/kg IV q24h<br>**PLUS**<br>Ampicillin 2 g IV q6h<br>**OR**<br>Ampicillin-sulbactam 3 g IV q6h<br>**PLUS**<br>Gentamicin 5 mg/kg IV q24h | Use 2-3 days; (expect improvement in 2-3 days in 90%.) | Consider MRSA coverage in patients with concomitant or recent surgical site infection. |

| Condition | Antibiotic Choices | Duration | Notes |
|---|---|---|---|
| Septic abortion/ retained products of conception (Tulandi and Al-fozan 2019; Wiesenfeld 2019; Workowski et al 2015) | Cefoxitin 2 g IV q6h<br>**OR**<br>Cefotetan 2 g IV q12h<br>**PLUS**<br>Doxycycline 100 mg PO (or IV) q12h<br>**OR**<br>Clindamycin 900 mg IV q8h<br>**PLUS**<br>Gentamicin 3 to 5 mg/kg IV daily | IV antibiotics should be given until the patient has improved and been afebrile for 48h, then followed by oral antibiotics to complete a 10 - 14 day course. | Bioavailability of oral doxycycline is 100%. |
| Acute pyelonephritis, empiric therapy (Hooton and Gupta 2019)<br><br>If concern for MDRO | Ceftriaxone 2 g IV q24h<br>**OR**<br>Cefepime 2 g IV q12h<br>**OR**<br>For severe penicillin allergy: Aztreonam 1 g IV q8h<br><br>Ertapenem 1 g IV q24h<br><br>Meropenem 1 g IV q8h | IV antibiotics should be given until significant clinical improvement, then followed by an appropriate oral agent to complete 10-14 days total antibiotic therapy.<br><br>As above, although there may be no oral option for MDRO. | |
| Hospital-acquired complicated intra-abdominal infection (Solomkin et al 2010)<br><br>A complicated intra-abdominal infection signifies an infection that extends beyond the hollow viscus of origin into the peritoneal space and is associated with either abscess formation or peritonitis.<br><br>A hospital-associated complicated intra-abdominal infection typically occurs after a surgical procedure or a bowel perforation in a hospitalized patient. | Piperacillin/tazobactam 3.375 g IV q8h (extended infusion) or 4.5 g IV q6h if not extended infusion<br>**OR**<br>Ertapenem 1 g IV q24h<br>**OR**<br>Meropenem 1 g IV q8h | Use 4-7 days if adequate source control. | Drainage (percutaneous or surgical) is key to managing intra-abdominal infections, and early consultation of interventional radiology or surgery is mandatory.<br><br>Empiric MRSA coverage is not routinely recommended. Consider in patients with colonized MRSA or who are at risk due to prior treatment failure and significant antibiotic exposure.<br><br>Antifungal therapy is recommended if Candida is grown from intra-abdominal cultures in severe community-acquired or healthcare-associated infection. |
| Pelvic abscess (Solomkin et al 2010; Wiesenfeld 2019)<br><br>Pelvic abscess can be an infectious complication of surgery (e.g., hysterectomy, cesarean delivery, induced abortion) or the result of infectious processes (e.g., pelvic inflammatory disease, inflammatory bowel disease, diverticulitis).<br><br>The source may be gastrointestinal (e.g. bowel perforation) or genitourinary (e.g. pelvic inflammatory disease). | For GI source: Use regimen for complicated intra-abdominal infection.<br><br>For GU source: Use regimen for septic abortion/retained products of conception. | | Early imaging and surgical or interventional radiology consultation for source control is important in managing pelvic abscess. |

| Condition | Antibiotic Choices | Duration | Notes |
|---|---|---|---|
| Necrotizing skin and soft tissue infection (severe, concern for necrotizing fasciitis) | Piperacillin/tazobactam 3.375 g IV q8h (extended infusion) or 4.5 g IV q6h if not extended infusion<br>**PLUS**<br>Empiric therapy:<br>Vancomycin per institutional protocol<br>**PLUS**<br>Clindamycin 900 mg IV q8h | Use 7-14 days. | Source control: Early surgical consultation mandatory in any patient in whom there is concern for necrotizing skin and soft tissue infection. |
| Necrotizing skin and soft tissue infection (Stevens et al 2014)<br><br>Known pathogens (monomicrobial) | Group A Streptococcus (*S. pyogenes*)<br>**OR**<br>Clostridium species (including *C. perfringens* and *C. sordellii*)<br><br>Penicillin 4 million U IV q4h<br>**PLUS**<br>Clindamycin 900 mg IV q8h | | |
| Community-acquired pneumonia (Mandell et al 2007) | Ceftriaxone 2 g IV daily<br>**OR**<br>Ampicillin-sulbactam 3 g IV q6h<br>**PLUS**<br>Azithromycin 500 mg IV/PO daily<br>**PLUS**<br>Oseltamivir 75 mg PO BID (during influenza season) | Use 5-7 days.<br>Patient should be afebrile for 48-72h without oxygen requirement before stopping antibiotics.<br><br>Use 5 days. | CDC guidelines are updated annually and are available at www.cdc.gov/flu/professionals/index.htm<br><br>Influenza season is generally October through March (but can go through May). |

## Notes:

1. Doses recommended in this table are based on normal renal function.
2. Severe allergies to beta lactams are defined as anaphylaxis, angioedema, bronchospasm, hives within 60 minutes of a dose, a penicillin-induced Stevens Johnson Syndrome or Toxic Epidermal Necrolysis. Without one of these complications from penicillin, the risk of an allergic reaction to a cephalosporin is approximately 1:1000.
3. For vancomycin dosing: Typical dosing is 15-20 mg/kg q8h-q12h (goal trough 15-20). Consider loading dose of 25-30 mg/kg in critically ill patients.
4. Other carbapenems with the same spectrum of activity as meropenem include doripenem 500 mg IV q8h, imipenem 500 mg IV q6h.

## Source Control

If patients have no improvement with initial resuscitation with antibiotics/fluids:

1. Patients with identified sources of infection that are amenable to percutaneous drainage should:
   a. Undergo consultation with interventional radiology and assessment for possible drainage.
   b. Consider consultation with infectious disease if appropriate.
2. Patients with identified sources of infection requiring surgery should undergo consultation with:
   a. Gynecologic surgeon for procedures such as dilatation and curettage for retained products, hysterectomy for necrotizing GAS uterine infection, or drainage of pelvic or perineal abscess not amenable to percutaneous drainage by interventional radiology.
   b. General surgeon for procedures such as drainage of abdominal abscess, appendectomy, cholecystectomy, or debridement for necrotizing fasciitis. Early surgical consultation is strongly recommended for any concerns regarding necrotizing skin and soft tissue infections.
3. Patients with identified sources of infection that are too small or not amenable to percutaneous drainage, or patients with undetected sources, or patients with refractory fevers despite antibiotics and supportive measures:
   a. Consider consultation with infectious disease or maternal fetal medicine.
   b. Also consider imaging studies to detect occult abscess or other infections.

**TABLE 11.** Imaging: Recommendations for Identifying Specific Sources of Infection

| Suspected Infection source | Antepartum Imaging | Postpartum Imaging |
|---|---|---|
| Appendicitis<br>(Williams and Shaw, 2007; Duke et al 2016; Burke et al 2015) | Graded compression ultrasonography is first choice. Sensitivity is 67-100%, specificity 83-96%.<br><br>MRI of the pelvis should be performed if ultrasound is inconclusive. Sensitivity is 94-97%, specificity 97-99%.<br><br>If MRI is not available, then CT scan can be performed if ultrasound is inconclusive. | Perform CT scan. |
| Cesarean delivery wound infection/surgical site infection (SSI) (CDC, Jan 2018) | N/A | Superficial Incisional SSI: No imaging needed because it is generally diagnosed on exam with culture and opening of the incision.<br><br>Consider ultrasound. |
| | | Deep Incisional SSI: Perform CT scan and ultrasound. |
| | | Organ/space SSI: Perform CT scan and ultrasound unless endomyometritis, which is usually diagnosed and treated clinically. |
| Cholecystitis | Right upper quadrant (RUQ) ultrasound is the most reliable modality for cholecystitis and cholelithiasis.<br><br>Magnetic resonance cholangiopancreatography (MRCP) may be helpful in cases of choledocholithiasis when ultrasound is not diagnostic.<br><br>Hepatobiliary iminodiacetic acid (HIDA) scan, while safe, can help to determine obstruction in cholecystitis but is rarely needed. | Perform RUQ ultrasound, MRCP, and HIDA scan, which involves a radioactive tracer. |
| Chorioamnionitis/intraamniotic infection<br>Endomyometritis<br>(ACOG CO 712) | Primarily diagnosed clinically | Primarily diagnosed clinically |
| Bacteremia/endocarditis | Diagnose using blood cultures paired with risk factors and symptoms (i.e. Duke's criteria) with imaging diagnosis by transthoracic echocardiogram (TTE) with sensitivity 75%. If patient is able to tolerate sedation, transesophageal echocardiogram (TEE) has better valve visualization with sensitivity 95%. | Perform TTE and<br>TEE (transesophageal echocardiogram). |
| Mastitis/breast abscess | Perform ultrasound with guided drainage for abscess. | Perform ultrasound with guided drainage for abscess. |

| Suspected Infection source | Antepartum Imaging | Postpartum Imaging |
|---|---|---|
| Necrotizing skin and soft tissue infection | Primarily diagnosed clinically<br>(See Box 5 and surrounding text, p. 25) | Primarily diagnosed clinically<br>(See Box 5 and surrounding text, p. 25) |
| Pelvic abscess<br>(Fouks et al, 2018) | Perform ultrasound. | Ultrasound is usually the first line choice for diagnosis due to cost and no radiation exposure. It is the best modality to demonstrate the pelvic organs with sensitivity for tubo-ovarian abscess (TOA) 75-82%.<br><br>Perform CT scan with IV and oral contrast with sensitivity for TOA 78-100%. Drainage recommended for abscess size ≥ 7 cm. |
| Pneumonia | Chest x-ray remains the gold standard when diagnosis suspected (i.e. shortness of breath, cough, fever, tachypnea, hypoxia).<br><br>CT-chest (low dose CT comparable with standard dose CT) is generally reserved for suspected Pulmonary Embolism with adjustments made from craniocaudal sections to avoid exposure to gravid uterus. | Perform chest x-ray and CT-chest. |
| Renal abscess/ urogenital tract<br>(Meyrier, 2017) | Perform ultrasound, MRI, and<br>CT scan with contrast only if necessary. | Perform CT scan with contrast. |
| Retained products of conception/ septic abortion | Perform ultrasound. | Perform ultrasound. |
| Septic pelvic thrombophlebitis<br>(Chen, 2018) | N/A | Perform CT scan with contrast OR magnetic resonance venography with gadolinium.<br><br>Ultrasound is not as useful.<br><br>Interpret imaging findings with caution and in combination with clinical signs and symptoms, since pelvic vein thrombosis is also highly prevalent in asymptomatic postpartum individuals, (20/30 women after spontaneous vaginal delivery in one study). |

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## In This Toolkit



# PART IV.
# Obstetric Considerations in the Case of Maternal Sepsis

## KEY PRINCIPLES:

1. The timing of delivery in a patient who is septic should be individualized, taking into consideration gestational age and maternal-fetal status.

2. In a patient with clinical signs and/or symptoms consistent with a diagnosis of sepsis or septic shock, avoidance of neuraxial procedures should be strongly considered in the risk assessment.

## Indications for Delivery

The Society for Maternal-Fetal Medicine (SMFM) concludes sepsis by itself "is not an immediate indication for delivery (except in cases of chorioamnionitis/intraamniotic infection)."[1] Rather, the timing of delivery in a pregnant woman who is septic should be individualized, taking into consideration gestational age and maternal-fetal status. Because improving maternal hemodynamics often improves fetal status, cesarean delivery is usually reserved for supervening obstetric indications after the woman is stabilized by instituting appropriate supportive and antibiotic therapy. When chorioamnionitis/intraamniotic infection is the source of infection in sepsis, delivery is indicated with the mode of delivery (cesarean vs. vaginal) and exact timing determined by maternal and fetal condition. The SMFM says "corticosteroids for fetal lung maturity are not contraindicated" in sepsis.[1]

## Anesthetic Considerations

### (Refer to Part II: Distinguishing Chorioamnionitis/ Intraamniotic Infection from Sepsis)

In patients with bacteremia, there is thought to be a theoretical increased risk of meningitis or spinal epidural abscess with neuraxial procedures due to seeding of the meninges, subarachnoid, or epidural space. Given the low rate at which this occurs, no study to date has been powered to exclude this possibility. We provide this information to help clinicians decide whether to provide neuraxial anesthesia. It is ultimately the decision of the anesthesiologist whether or not to perform neuraxial procedures.

## Screen positive patients

In a patient with confirmed or suspected bacteremia, a thorough assessment should be performed, including a history, physical exam, and review of laboratory values. As previously covered, it is not uncommon for pregnant women to have elevated WBC counts or lactic acid as a result of the labor process itself.[2-3] In patients diagnosed with chorioamnionitis, there is a reported incidence of bacteremia in 5-12% of patients.[4] Two studies with a total of 810 patients diagnosed with chorioamnionitis receiving neuraxial procedures assess outcomes. Many patients were febrile at the time of neuraxial procedure placement without prior antibiotic therapy; both studies did not report any cases of spinal epidural abscess or meningitis.[5-6] Because it is rare a neuraxial infection occurs after a neuraxial procedure in patients with suspected bacteremia, consideration should be given to the higher risk of failed intubation in pregnant women (1 in 390).[7] We recommend an anesthesiologist perform neuraxial procedures in patients at risk for bacteremia. Prior to neuraxial procedures, appropriate preprocedural antibiotic therapy should be administered and infusion(s) completed, as research has shown that antibiotic therapy administered prior to neuraxial procedures mitigates this risk.[4,8-9]

## Sepsis/septic shock

In a patient with clinical signs and/or symptoms consistent with a diagnosis of sepsis or septic shock, avoidance of neuraxial procedures should be strongly considered in the risk assessment. The physiologic status of the patient with sepsis or septic shock is compromised and the cardiovascular effects of a neuraxial block technique may cause further detriment in an already critical clinical situation, with high potential for maternal (and fetal) morbidity and mortality.

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## In This Toolkit



# PART V.
# Discharge Education

## KEY PRINCIPLES:

1. Every woman and at least one support person should receive discharge instructions on the danger signs of sepsis.
2. Instructions at every point of care should include ways to decrease infection risk, such as frequent hand washing.
3. For women who have had sepsis, follow-up contact should be made within 3-4 days after discharge.

The California Pregnancy-Associated Mortality Review Committee provides important lessons for providers. The mean time between giving birth and a woman's death from sepsis was 6.9 days with the median at 2.0 days postpartum.[1] A significant number of women who develop sepsis are not being identified during the delivery hospitalization. For this reason, discharge education reinforcing "Danger Signs" associated with infection should be presented to the patient and support persons. Patients with sepsis during their delivery hospitalization should have contact with their healthcare provider **within 3-4 days** of discharge, as opposed to the typical scheduled visit at six weeks postpartum.

## Case Presentation:

Carolyn was a 26-year-old who gave birth vaginally to an 8lb 12oz newborn after an uneventful labor. She experienced a 2nd degree laceration that was repaired without complication. She was discharged home on postpartum day two. On postpartum day four, she presented to urgent care reporting abdominal pain and a temperature of 38.4°C (101.2°F). She was diagnosed with dehydration and her temperature was attributed to the onset of lactogenesis as she was breastfeeding her infant. She was sent home without a perineal examination. She presented again on postpartum day six to the emergency room of her delivery hospital with a temperature of 39.8°C (103.8°F), chills, abdominal pain 10/10, and hypotension. She was diagnosed with sepsis and admitted to the ICU, but expired 12 hours later despite antibiotic administration and fluid resuscitation. The coroner's report noted that family said she had been complaining of feeling ill for days. Cause of death was necrotizing fasciitis of the vaginal laceration.

## Lessons Learned:

This missed opportunity was early recognition of sepsis. Carolyn returned to hospital with fever and abdominal pain. A full evaluation including physical exam and lab work-up was not performed, thus, leading to false assumptions regarding a differential diagnosis. Antibiotics were not given. Wound infection/necrotizing fasciitis is a medical emergency and it is important to begin treatment promptly. Broad-spectrum antibiotics should be administered within one hour as every hour of delay increases mortality. The missed opportunity for early recognition was when Carolyn was discharged home on postpartum day four. When Carolyn returned on postpartum day six, she was in septic shock. Mortality rate is 30-60% for patients in septic shock with necrotizing fasciitis most likely due to GAS. With earlier recognition and treatment, this death was likely preventable.

## Case Presentation:

'Leanna' was a 24-year-old nullipara at 24 weeks gestation who presented to OB triage with fever of 38.3°C (101.0°F), right-sided flank pain, and vomiting. Her heart rate was 120/min. Fetal tachycardia was 170/min. Urinalysis showed positive nitrites, many WBCs, and bacteria. Urine culture was pending. She was discharged home with instructions to take nitrofurantoin as prescribed and return to the hospital if she experienced persistent fever, feeling worse, or had contractions. Patient returned six hours later with fever of 38.9°C (102°F) and right sided flank pain, nausea and vomiting. In addition, she felt short of breath and dizzy. Her blood pressure was noted to be 85/52 mm Hg, MAP 64. A septic work-up was performed. Intravenous ampicillin and gentamicin antibiotics were initiated for suspected pyelonephritis and a fluid 30 mL/kg fluid bolus was given. Patient was admitted to the high-risk maternity unit. Three hours later, patient remained short of breath, requiring oxygen. Oxygen saturation was 90% and lactic acid was 2.6 mmol/dL. BP remained low at 85/50. A RRT nurse was called to the bedside and performed a dynamic assessment with the non-invasive cardiac monitor to determine fluid responsiveness. A 250 mL fluid bolus was given while measuring the SVI and stroke volume percentage change. The SVI was greater than 10% with intravenous fluid challenge suggesting the patient was fluid responsive to IV fluid administration. The patient received another 30 mL/kg fluid bolus for lactate above 2 mmol/dL and hypotension. The intensivist instructed the RRT nurse to transfer the patient to ICU. The patient was unable to keep oxygen saturation above 90%; therefore, the patient was intubated and a central line was placed. The patient remained in ICU for three days with condition guarded. An ultrasound was done to determine a blocked infected ureter. A nephrostomy tube was placed. The urine culture indicated Enterococcus Coli greater than 100,000. Leanna's condition improved and she was transferred to high-risk maternity. She was discharged five days later with a nephrostomy tube in place. She returned to the hospital at 40 weeks to deliver a healthy baby girl.

## Lessons Learned:

In this case, there was a missed opportunity of performing a lab work-up when the patient first presented to the hospital. She had two screening criteria including an elevated heart rate above 110/min and a temperature above 38°C (100.4°F). When the patient returned to the hospital, she was experiencing vascular collapse as evidenced by hypotension despite fluid bolus. Early screening and treatment is the key to decreasing morbidity and preventing mortality for patients with sepsis.

## Post Sepsis Care

Although not specifically studied in cases of maternal sepsis (a younger population), survivors of sepsis can have cognitive impairment, psychologic sequelae, higher rates of re-hospitalization, recurrent infection and death.[2] This may be similar to the well described post-ICU syndrome. Patients should be promptly referred for rehabilitation for weakness and cognitive impairment. All patients should be screened for depression, anxiety, and post-traumatic stress disorder and receive prompt treatment. Patients should establish a relationship with a primary care physician to assure multi-disciplinary follow-up and treatment. Surveys of adult sepsis survivors indicate that many patients report continuing difficulties with anxiety, depression, fatigue and sleep disturbance indicating the need for support services during hospitalization and post discharge.[3]

**BOX 6.** Sample Discharge Instructions

| Box 6: Sample Instructions in Every Care Delivery Setting<br>(Include these points in your standard discharge instructions in every delivery care setting) |
|---|
| Contact a healthcare provider if you have:<br>• A temperature of 38°C (100.4°F) or higher<br>• An incision that is not healing (episiotomy, perineal laceration, or cesarean birth)<br>• Increasing pain at any incision site<br>• Increased redness, drainage, or pus of any incision or laceration<br>• Foul smelling bleeding or discharge from vagina or incision<br>• Pain unrelieved by discharge medication |

Include these discharge instructions within your standard postpartum discharge teaching (see AHWONN discharge instructions) that cover the full breadth of potential complications.

Including family members or other support persons in discharge teaching provides an added layer of safety. Family members/support persons should encourage the patient to seek care when she is at her most vulnerable. If the woman complains of not feeling well, has a fever, or is too weak to contact or visit her provider, the family members/support persons should immediately seek help on her behalf.

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## In This Toolkit



# PART VI.
# Appendices



## Appendix A

# Comparison of Sepsis Terminology

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| Comparison of Terms used by CMQCC, CMS Sepsis-1, and Sepsis 3 | | | |
|---|---|---|---|
| Clinical Criteria | *CMQCC* | *CMS Sepsis-1*[1] | *Sepsis-3*[2] |
| Sepsis screening positive criteria | CMQCC Initial Sepsis Screen (two or more and suspected infection) | SIRS (two or more and suspected infection) | qSOFA (two or more criteria) |
| Sepsis | CMQCC Initial Sepsis Screen Positive and one or more signs of organ dysfunction | SIRS (two or more) and infection | Organ dysfunction (SOFA score of two or more from baseline) caused by infection |
| Severe Sepsis | Not used | Sepsis and organ dysfunction | Not used |
| Septic shock | Sepsis AND persistent hypotension after crystalloid administration defined as MAP < 65 mm Hg | • Severe sepsis and lactic acid ≥ 4 mmol/L*, OR<br>• Severe sepsis and persistent hypotension as defined as SBP < 90 mm Hg OR<br>• MAP < 65 mm Hg OR<br>• > 40 mm Hg decrease in SBP | Vasopressor requirement to maintain MAP > 65 mm Hg AND persistent hyperlactatemia (lactic acid ≥ 2 mmol/L*) despite adequate fluid resuscitation |

*Lactic acid may be elevated during labor and recently postpartum. Interpret lactic acid results with caution and provide a full evaluation (as described above) with elevated lactic acid levels.

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# Appendix B
## CMS Sepsis-1 Accommodations for Special Populations

To meet CMS Sepsis-1 Requirements for reimbursement for sepsis, accommodations can be made for specific patient types if there is appropriate justification. These justifications are provided below and are intended to be shared with hospital departments that oversee quality improvement.

| Justification for Variance from CMS Sepsis-1 Requirements in Pregnancy | | |
|---|---|---|
| *Requirement Recommended for Variation by CMQCC* | *Justification* | *CMS Statement and Page Numbers in Version 5.5a to Use for Justification* |
| SIRS criteria for screening | SIRS criteria in pregnancy do not accurately predict sepsis. Due to physiological changes of pregnancy, many healthy pregnant women will meet SIRS criteria without infection. | "If SIRS criteria or a sign of organ dysfunction is due to an acute condition that has a non-infectious source/process, it should not be used. The abnormal value should be referenced in the same documentation." Pg 1-172 |
| Signs of organ dysfunction (SBP < 90 mm Hg, creatinine > 2mg/dL, lactic acid > 2mmol) | Please see "Justification Discussion for CMQCC Pregnancy Adjustments to Criteria for End Organ Injury" for different thresholds for SBP, creatinine, and lactic acid, Appendix C, pg 43. | "If SIRS criteria or a sign of organ dysfunction is due to an acute condition that has a non-infectious source/process, it should not be used. The abnormal value should be referenced in the same documentation." Pg 1-172 |
| Blood cultures should be drawn prior to antibiotic administration | Blood cultures are frequently not drawn prior to administration of antibiotics for chorioamnionitis, and timely administration of intravenous antibiotics is necessary. Per Gabbe S, Obstetrics, "Cultures will be positive in 5% to 10% of patients; however, they will usually not be of value in making clinical decisions…" | "Antibiotics were started in the hospital for an infection within 24 hours before severe sepsis was identified, and a blood culture was drawn sometime after the antibiotic dose was started." Pg 1-31 |

The CMS Definitions can be found by clicking on the link provided, scrolling down to Section 1 – Data Dictionary and selecting the "Alphabetical Data Dictionary" link. CMS Data Dictionary Link

CMS = Centers for Medicare and Medicaid Services; CMQCC = California Maternal Quality Care Collaborative; SIRS = systemic inflammatory response syndrome; SBP = systolic blood pressure

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## Appendix C

# Justification for Adjustments to CMS Sepsis-1 Criteria for End Organ Injury

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## Systolic blood pressure

Systolic, diastolic, and mean arterial blood pressure decrease during normal pregnancy and reach a nadir in mid-pregnancy with subsequent increases as gestational age increases.[1-2] A study evaluating frequency of Maternal Early Warning Criteria triggers found that 45 (15%) of healthy women had a SBP < 90 mm Hg.[3] In a study of 32,161 patients reporting vital signs during delivery hospitalization to determine a normal range, it was found that 5% of women had SBP < 90 mm Hg and 2.5% of women had a SBP < 85 mm Hg or lower during the intrapartum and postpartum periods.[4] CMQCC chose the threshold of < 85 mm Hg for diagnosis of sepsis-related end organ injury to reduce frequency of alerts due to physiological changes of pregnancy alone.

## Creatinine

Serum creatinine levels decrease during pregnancy due to a rise in glomerular filtration rate. Normal serum creatinine levels during pregnancy range from 0.5 mg/dL to 0.7 mg/dL.[5] It is well established that creatinine ≥ 1.2 mg/dL or doubling of creatinine are considered diagnostic for renal end organ injury for preeclampsia, and CMQCC chose to adopt these lower levels for diagnosis of sepsis-related end organ injury.[6]

## Lactic acid

Lactic acid may be elevated during normal labor and delivery. In a meta-analysis of 2,008 observations of 1,193 normal healthy women during pregnancy, labor, and delivery, assuming a normal distribution, 99.7% of patients had a lactic acid < 2 mmol/L outside of labor. For patients (not in labor with suspected infection) whose Step-1 Initial Sepsis Screen is positive and have a lactic acid > 2 mmol/L, they meet the criteria for diagnosis of sepsis per CMS. However, during all stages of labor and time of delivery, lactic acid levels > 2 mmol/L were reported within the normal range as a result of labor alone. More specifically, out of 10 studies reporting lactic acid levels at the time of delivery, nine reported levels > 2mmol/L and six reported lactic acid levels > 4 mmol/L due to labor.[7] Due to the wide ranges reported during labor, it is difficult to determine the expected percentage of women with elevated levels as a result of labor. Although there may be some women with elevated lactic acid levels due to anaerobic metabolism during normal labor, there is considerable harm that may occur with untreated worsening infection that may present with rising lactic acid levels.[8-10] For laboring patients (with suspected infection) whose Step-1 Initial Sepsis Screen is positive and do not meet any end organ injury criteria but have a lactic acid > 2 mmol/L, we recommend close surveillance, bedside assessment for additional fluid administration, and repeated lactic acid levels over time.

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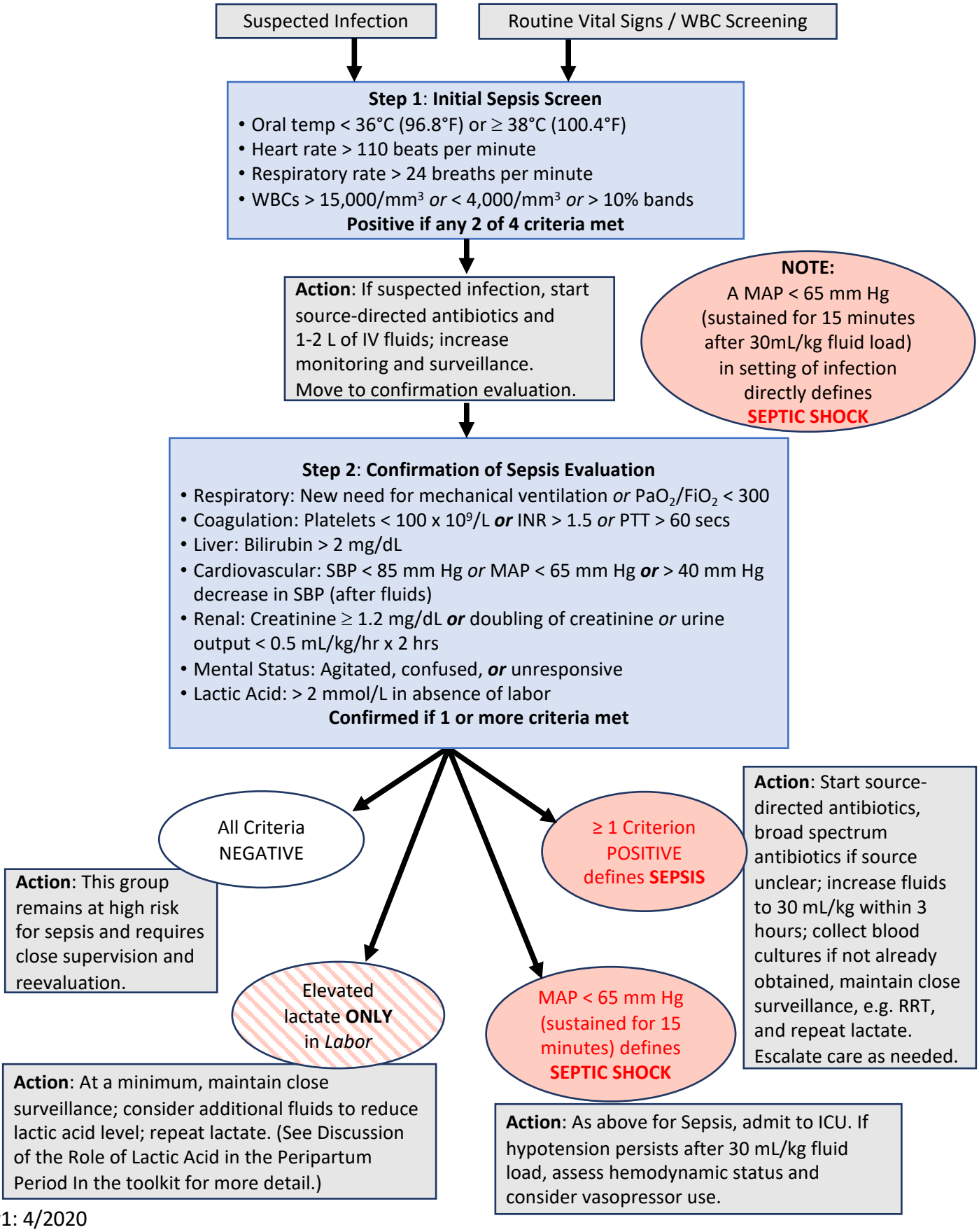
**Appendix D**

# Maternal Sepsis Evaluation Flow Chart



## Appendix E

# Collecting a Urine Specimen from a Foley Catheter

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(Permission to use and adapt from Shepherd E (2017) Specimen collection 2: obtaining a catheter specimen of urine. Nursing Times 113 8:20-21. www.nursingtimes.net/clinical-archive/assessment-skills/specimen-collection-2-obtaining-a-catheter-specimen-of-urine-10-07-2017

Indwelling urinary catheters are attached to a drainage bag to create a closed system. Breaking this closed system by disconnecting the catheter from the drainage device can increase the risk of a patient developing a catheter-associated urinary tract infection (CAUTI). Samples should not be collected from the drainage bag, as the specimen may be contaminated. Ideally, samples should be collected before antibiotics are administered as they may affect the laboratory result. A catheter specimen must be obtained from the sampling port on the catheter bag. Sampling ports are designed to be accessed directly using a Luer Lock syringe and do not require a needle.

## Equipment

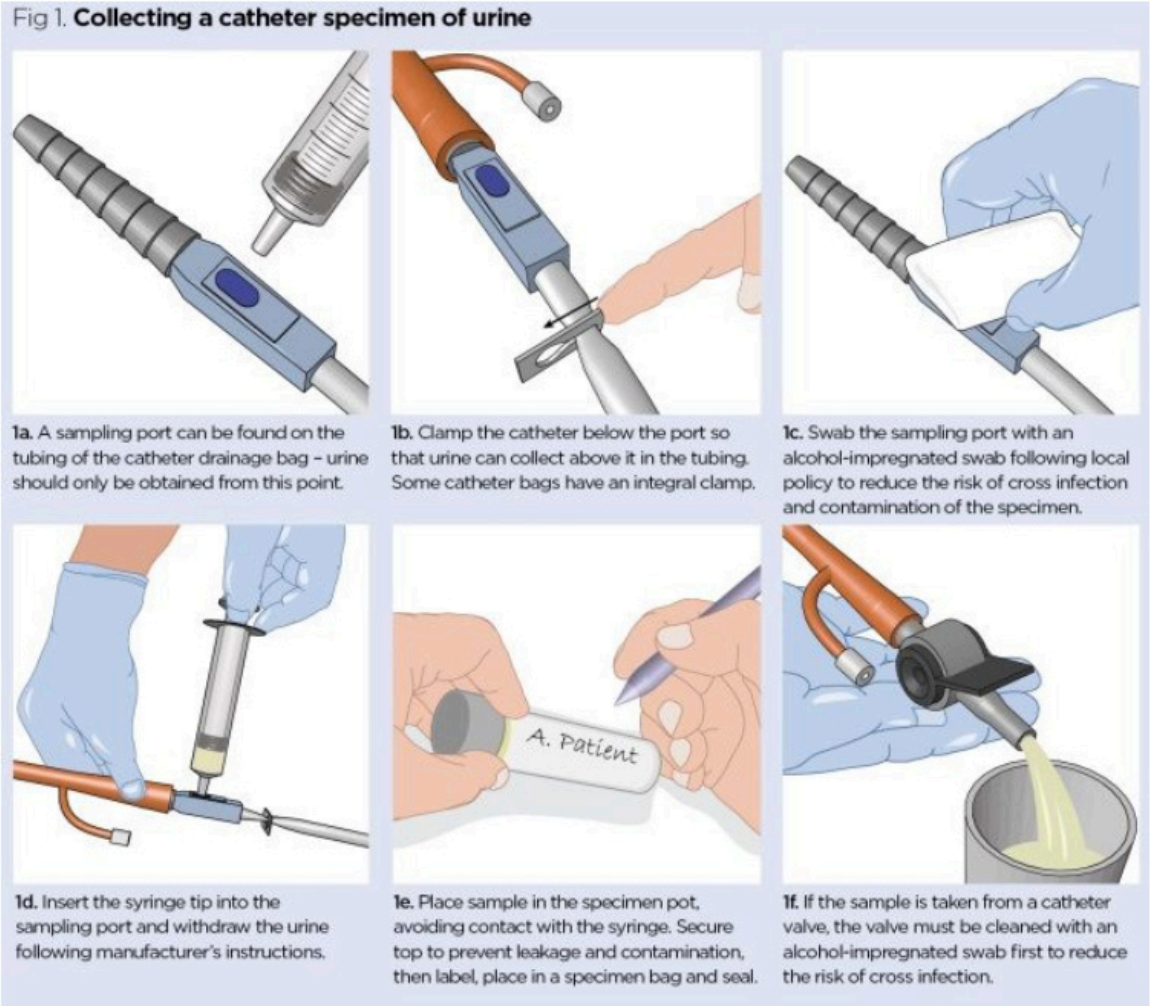
- Personal protective equipment (i.e. gloves)
- Sterile 10ml Luer Lock syringe
- Non-traumatic clamp (if catheter does not have a slide clamp)
- Sterile specimen container
- Prep wipes

## Procedure

(See Figure 1 on next page)

1. Introduce yourself to the patient and verify the correct patient using two identifiers.
2. Explain the procedure to the patient and gain informed consent to obtain the specimen. Explain why the specimen is being collected, when the results will be available, and implications for treatment.
3. Ensure the patient is comfortable and that privacy and dignity is maintained throughout the procedure.
4. Wash your hands, prepare equipment, and apply personal protective equipment.
5. If taking a specimen from a sampling port (Fig 1a), check first whether there is urine in the catheter tubing. If the tubing is empty, apply a clamp approximately 3 inches below the level of the sampling port (Fig 1b). This allows urine to collect above the clamp so that a sample can be obtained.
6. Clean the sampling port with a prep wipe according to policy and allow to dry (Fig 1c).
7. Stabilize the tubing by holding it below the level of the sampling port.
8. Insert the syringe tip into the sampling port (following manufacturer's instructions) (Fig 1d). Be careful to protect the sterile syringe tip and disinfected sampling port from contamination.
9. Aspirate at least 10 mL of urine and disconnect the syringe.
10. Put the urine into a sterile specimen container, avoiding contact between the syringe and the cup (Fig 1e). Ensure the top of the specimen container is secured to prevent leakage and contamination of the specimen.
11. Wipe the sampling port with a prep swab and allow it to dry. This reduces the risk of cross infection and contamination.
12. If a clamp was used, release it to allow urine to drain freely. Failure to do this will cause the bladder to fill and can result in discomfort.
13. Remove and dispose of personal protective equipment, and perform hand hygiene.
14. Label the specimen and place in a specimen bag following policy.
15. Send the sample to the laboratory immediately or refrigerate until it can be transported to ensure accurate results are obtained.
16. Document the date and time the sample was collected.

# Appendix E
## Collecting a Urine Specimen from a Foley Catheter




*Permission to use Figure from Peter Lamb. Text was reproduced with permission of Nursing Times.*

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## Appendix F

# The Importance of Taking a Respiratory Rate

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The respiratory rate (RR) is a vital sign, but is frequently omitted, inaccurately measured or not recorded.[1] Respiration measurements are not viewed as a priority possibly due to automation and may not be routinely available on labor and delivery units.[2] Most vital signs are done with automatic machines, whereas there is no technology for respiratory monitoring and measurements must be manually recorded into the electronic medical record.

Semler et al. (2013) found a significant difference between actual RR and the one that was recorded.[3] Out of 368 recordings, 72% indicated 18 or 20 breaths per minute whereas only 13% were within that range. In another study of 211 postoperative patients, 15% of the RR were not documented.[4]

When counting the RR, patients may alter their breathing when they know they are being watched.[2] Techniques to assist in obtaining an accurate RR include discreetly counting respirations while checking the radial pulse. Assessment of respirations should include observing a full cycle of breath for 30-60 seconds.

A small change of the patient's normal RR of 3-5 breaths per minute could be an early sign of deterioration.[5] Therefore, a RR outside of the normal range should be monitored closely. Monitoring and recording of the RR should be part of the patient's assessment. It must be interpreted in the clinical context of the patient's presentation as well as other aspects of respiration including depth, pattern, and effort of breathing. For patients with possible sepsis, the accurate documentation of the RR is crucial, as the body will increase the RR in an attempt to maintain oxygen delivery to the tissues.

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# Appendix G
# How to Take an Oral Temperature Measurement

Failure to obtain an accurate temperature can result in improper treatment. The validity of temperature comparisons is greatest when the thermometer type and measurement location are consistent. Caution should be taken when identifying trends or comparing temperatures obtained using different methods.

The purpose of measuring body temperature is to obtain a representative average temperature of core body tissues. Although no individual peripheral site correlates exactly with core temperature, a site near a major artery gives the most accurate measurement. Sites reflecting core temperature (e.g. rectum, tympanic membrane, esophagus, pulmonary artery, and urinary bladder) are more reliable indicators of body temperature than sites reflecting surface temperature (e.g. skin, oral cavity, and axilla). Rectal temperature measurement is thought to reflect core body temperature most closely. However, since rectal temperatures are not routinely performed on adult patients, the oral site is the preferred consistent location. For oral temperatures, the sublingual pocket in the mouth is close to the sublingual artery. The probe should be placed under the tongue in the posterior sublingual pocket lateral to the center of the lower jaw. The normal range for oral temperature is 36.2°C - 37.7°C (97.2°F - 99.9°F).

## Procedure

1. Introduce yourself to the patient and verify the correct patient using two identifiers.
2. Determine the previous baseline temperature and measurement site from the patient's record.
3. Assess the patient for signs and symptoms of temperature alteration.
4. Wait 20 to 30 minutes after the patient smokes, eats, or drinks a hot or cold liquid. Consider delaying temperature assessment for one hour after delivery or any strenuous activity.
5. Obtain an oral thermometer device. If the patient is on isolation precautions, use a disposable thermometer.
6. Perform hand hygiene and wear gloves.
7. Explain the procedure to the patient and obtain verbal consent.
8. Remove the oral thermometer probe from the electronic thermometer housing unit. Grasp the top of the probe stem, being careful not to apply pressure on the ejection button. Slide the disposable cover over the temperature probe until it locks in place.
9. Ask the patient to open his or her mouth. Gently place the temperature probe under the tongue in the posterior sublingual pocket lateral to the center of the lower jaw.
10. Instruct the patient to hold the temperature probe with lips closed.
11. Leave the temperature probe in place until an audible tone indicates completion and the patient's temperature reading appears on the digital display. Remove the probe from under the patient's tongue.
12. Push the ejection button on the temperature probe to discard the probe cover into the proper trash receptacle.
13. Wipe the probe with approved cleaner, paying attention to ridges where the probe stem connects to the top. Avoid touching the probe cover to reduce the transmission of microorganisms.
14. Insert the temperature probe back into the housing unit.
15. Disinfect the thermometer with approved equipment cleaner.
16. Discard supplies, remove gloves, and perform hand hygiene.
17. Inform the patient of the temperature reading, if appropriate.
18. Return the thermometer to its assigned storage space.
19. Report abnormal findings to the provider.
20. Document the procedure in the electronic health record

*For illustration and other information, please see Clinical nursing skills & techniques by Perry, A.G., Potter, P.A., & Ostendorf, W. (2018). St. Louis, MO: Elsevier*

# Team Reassessment Communication



Adapted from Team STEPPS training course; any similar communication program is also recommended.

Communication is a key factor in early recognition and treatment of sepsis. Learning to use effective communication techniques between disciplines will enhance perinatal patient outcomes and decrease maternal morbidity. The goal is to advocate for early recognition and treatment of sepsis. As with any new practice, you may encounter resistance in establishing a treatment plan for early recognition of sepsis in the perinatal population. Empower your teams to advocate for the patients by asserting a corrective action in a ***firm*** and ***respectful*** manner. Standards of effective communication include being: ***Complete, Clear, Brief*** and ***Timely***.

*ENCOURAGE A CULTURE OF BEING PROACTIVE, AND NOT REACTIVE.* This can be done by performing briefs and debriefs. The brief is a way to plan ahead, while debrief is more of a means of process improvement. Anyone can request a brief or debrief.

## Briefs: Planning

A key part of everyday practice is to encourage a shared mental model, which provides a shared understanding of what needs to be done.

- Know the Plan
- Share the Plan
- Review the Risks
- Encourage input from all

## Debrief: Process improvement

Teams participate in brief, informal information exchanges and feedback sessions following an event to enhance future patient outcomes and improve teamwork skills.

- Reconstruct key events
- Analyze why the event occurred
- Reflect on what could be done differently next time

## Communication techniques that will assist with prompt recognition and treatment

✓ Time out
✓ SBAR (situation, background, assessment, recommendation)
✓ CUS (concerned, uncomfortable, safety issue)
✓ Closed loop communication
✓ Handoff

## Time Out and SBAR

Any team member who wishes to regain situational awareness and express concern can call a 'time out.' When a time out is called, include all multidisciplinary members of the team and provide an SBAR report to ensure every one is on the same page with the treatment plan.

A time out is key in the early recognition phase of sepsis. It can be called as needed to assist the team in "touching base" and to regain situational awareness. It can be used to discuss critical issues and emerging events as well as anticipate outcomes and likely contingencies. The time out can also be used to assign resources and express concerns. A SBAR report can be used to communicate the following information:

- *Situation*–What is going on with the patient?
- *Background*–What is the clinical background or context?
- *Assessment*–What do I think the problem is?
- *Recommendation*–What would I recommend?

## Example of an SBAR for a perinatal patient with sepsis

- *Situation*–Patient Jane Doe has met sepsis screening criteria.
- *Background*–Jane is G4P2 EGA 39.6 weeks admitted for SROM > 24hrs. Patient has been augmented with oxytocin and is making appropriate progress in her labor. GBS is negative and she has no other known risk factors.
- *Assessment*–Jane's vital signs are Temp 38.4°C, Pulse 120/min, BP 110/68 mm Hg, $pO_2$ 96% on room air, Category 2 tracing. Jane appears to meet the initial sepsis screening criteria.
- *Recommendation*–"My recommendation is to initiate test for confirmation of sepsis, including laboratory tests 1 L of fluid and increased monitoring. Would you like to start antibiotics? I will report back results for further orders."

## Use CUS words to advocate: CUS (concerned, uncomfortable, safety issue)

Use CUS words if there is resistance for sepsis screening and you receive a response similar to the following examples:

- "It is not sepsis, it is chorio. We will treat for chorio."
- "We will continue to monitor her; sepsis screening is not necessary."
- "It is normal in pregnancy to have those vital sign changes; it is not sepsis."

## Examples of CUS

- "I am **concerned** that the patient might become septic from the chorioamnionitis/intraamniotic infection. Early recognition and treatment is important and I would like to initiate the sepsis screening process"
- "I am **uncomfortable** with waiting to initiate the sepsis screening and I would like to activate the order set so that we can promote early recognition and treatment if indicated."
- "Although vital signs are elevated in pregnancy, her current vital signs meet sepsis screening criteria. This is now a **safety issue** we must address."

## Closed loop communication

When initiating treatment for sepsis, it is essential that all members of the team use clear and precise communication regarding tasks completed and those that are still pending. At the bedside, closed loop communication is key to ensure the message has been clearly heard and received.

## Example 1 of closed loop communication

- **Nurse to charge nurse**: "The patient has 2 vital signs that meet sepsis screening criteria. We need to draw sepsis screening labs and notify the physician."
- **Charge nurse to nurse**: "I will find a staff member to help you draw sepsis screening labs, and I will page the physician so that you can provide report."

## Example 2 of closed loop communication

- **Nurse to physician**: "Initial lactic acid result is 3.2 mmol/L. We are requesting your prompt presence at the bedside for assessment. What orders would you like me to initiate at this time?"
- **Physician to nurse**: "I am on my way in to the hospital to assess the patient and about 20 minutes away. Please initiate fluid resuscitation of 30 mL/kg. I will order antibiotics when I arrive after evaluating the source."
- **Nurse to physician**: "We will initiate fluid resuscitation now. We will expect you at the bedside in the next 20 minutes."

## Handoff

The handoff defines the transfer of information during transitions in care across the continuum; it includes an opportunity to ask questions, clarify, and confirm. Applying a standardized approach to handoff communication is recommended to ensure that tasks that have been completed in sepsis treatment have been adequately reported, as well as next steps.

## Example of handoff

RN to RN: "Patient Jane Doe met criteria for the sepsis screening order set. We drew labs, lactate, and blood cultures. Her lactic acid result was 3.8 mmol/L. We notified the physician and he is on his way in to assess the patient, and we expect him to arrive in the next 10 minutes. He ordered a fluid bolus of 30 mL/kg that we have initiated. The physician stated that he will order antibiotics after assessing the patient.

The charge nurse is aware of the situation, and I have also given report to the rapid response team regarding the patient's status. Jane is on continuous fetal monitoring, continuous pulse oximetry, and will need Q30 min BP and Temp until her lactic acid level is above 2.0 mmol/L. She will need a repeat lactate 2 hours from the first draw. Do you have any questions?

## Simulation of maternal sepsis to emphasize communication techniques

Multidisciplinary simulation of maternal sepsis is an ideal way to reinforce the workflow and interventions when sepsis screening criteria is met. Focus your simulation on communication approaches and the immediate actions of the bedside team. Pause the simulation as necessary to emphasize educational elements. If possible, use an actual patient scenario as your simulation storyboard, with actual vital signs. Make sure to disclose this during debriefing of the simulation. This gives the team participating insight into areas of improvement. The following is an example of a storyboard for maternal sepsis simulation as well as a debriefing tool that can be used after simulation or after an actual patient case.

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**Appendix I**

# Sample: Maternal Sepsis Debriefing Form

| **Maternal Sepsis Debriefing** | | | |
|---|---|---|---|
| Person Completing Form: | | Date/Time: | |
| Patient's demographic label: | | Team members present: | |
| | | | |
| | | | |
| | | | |
| | | | |
| **Team Attendance** | **Yes** | **No** | **Comments** |
| Notified charge appropriately | | | |
| Notified OB team appropriately | | | |
| Notified RRT team appropriately | | | |
| Notified code blue pharmacist | | | |
| Adequate help present | | | |
| Clear roles/stayed in roles | | | |
| **Intervention** | **Yes** | **No** | **Comments** |
| Order set 601 by RN for sepsis | | | |
| Order set 600 by MD for sepsis | | | |
| RRT to bedside for sepsis | | | |
| Lactic acid | | | |
| CBC | | | |
| BMP | | | |
| Blood cultures | | | |
| Central venous access | | | |
| **Medication** | **Yes** | **No** | **Comments** |
| Fluids bolus | | | |
| Broad spectrum antibiotics | | | |
| **Additional Comments:** | | | |
| **What went well:** | | | **What Needs improvement?** |
| Teamwork | | | Teamwork |
| Communication | | | Communication |
| Leadership | | | Leadership |
| Other | | | Other |
| Patient | Remained on D3/T3 | | Return completed form to organizer on L&D. If topics pertain to safety issues that need to be immediately addressed, return directly to: |
| | ICU transfer | | |

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UCDAVIS HEALTH

## OB MATERNAL SEPSIS SCENARIO

### Preparation:

- ✓ **Mannequin, delivered with baby skin to skin Patient name DEBRA HULAHOOP**
- ✓ **Add patient band on mannequin with MRN/DOB/name**
- ✓ **Labor in bed broken down for delivery/repair**
- ✓ **Del table set up- repair in progress**
- ✓ **IV LR w Pitocin infusing, Magnesium infusing**
- ✓ **2 extra Pumps available for IV Tylenol and Abx**
- ✓ **Tylenol IV labeled in Pyxis drawer**
- ✓ **MD to start in room at start of scenario**
- ✓ **WOW at Bedside for practice if EMR component**
- ✓ **For order set 601 use "NURSE Order set"**
- ✓ **For order set 600 use "MD Order set"**
- ✓ **Have Sepsis Kits readily avail/ discuss before SIM**

### Scenario #1:

34 yo G1 P1 s/p vaginal delivery
Was admitted for Induction of labor for postdates
developed preeclampsia with severe features(mild BPs, inc Cr & AST), treated with magnesium sulfate, continues with MAG running at start of scenario, She was AROM @ 0000, 2nd stage of labor 3 hrs
Delivers @ 11:05 am , and has a complex 4th degree laceration, She is being repaired at the start of the scenario
Her QBL was 705ml , She also had Uterine atony and was treated with SL **misoprostol** 400 mcg
It is 11:45am at the start of scenario and the Physician is still repairing the patient

| Time | Scenario Flow | Actions by team | Reactions by mannequin/simulationist |
|---|---|---|---|
| 0:00 | Shaking after delivery | Continue repair<br>Anesthesia -> Demerol | Shaking, "I really don't feel well"<br>Not able to get vital signs |
| 0:05 | Shaking improved | MD continues repairing | T 38.6 temp oral, 40 axillary HR 124, BP 147/68, RR 26 |
| 0:05-0:15 | SIRS alert- **TIME ZERO** | Notify MD | The MD says "it's because of the sublingual misoprostol that her temp is high" |
| **PAUSE** | **SIRS ALERT**<br>**Talk through the criteria that triggered the alert** | **LEAD THEM TO ORDER SET 601-RN order set**<br>***complete PAUSE if they have not performed these steps**<br>• Draw labs (CBC, BMP, lactic acid) | |

UCDAVIS HEALTH

## OB MATERNAL SEPSIS SCENARIO

| Time | Scenario Flow | Actions by team | Reactions by mannequin/simulationist |
|---|---|---|---|
| | Pt starts to shake again | MD continues with repair | "I really don't feel well" |
| 0:25<br>Facilitator reports 10 minutes from Labs sent | Labs returned<br><br>Labs: WBC 23.8, Hgb 12.5, Hct 38, plts 167; lactic acid 5.8<br><br>RRT NOT in room although notified of lactic acid >4 | **MD to enter order set 600-MD order set**<br>Rapid response called/Sepsis RN<br><br>IV fluid bolus ( 30 ml/kg over 3 hours)<br>Blood cultures | T 38.6 temp oral, 40 axillary, HR 124, BP 123/57, RR 26 |
| **PAUSE** | **LAB RESULTS** | **LEAD MDs TO ORDER SET 600**<br>**.Initialsepsisdoc**<br>***complete pause if they have not performed these steps**<br>• **Is RRT at BS**<br>• **Has CHG RN been notified** | |
| **PAUSE** | What if you weren't able to get blood cultures within 45 min of **TIME ZERO** what do you do? | Blood cultures **(unable to get blood cultures after attempting for >45 minutes)**<br><br>Antibiotics ordered **(start abx after attempting blood cultures for 45 minutes, then continue to attempt blood cultures)** | |
| 0:45 | Pharmacy technician delivers Antibiotics | Hang Antibiotics<br>Reassure Patient and family regarding patient status and baby status | "What's going on? Where is my baby?" |
| 1:10 | | Consider transfer to ICU, pressors, central venous access | Patient confused ( change in AMS)<br>T 38.2 temp oral, 40 axillary, HR 132, BP 85/53, RR 28 |

Debrief using tool to ensure all elements are discussed

## Appendix K

# Maternal Sepsis Sample Education Outline

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Providing education on some key maternal sepsis concepts will assist in routine screening for sepsis and providing treatment as necessary. A suggested outline is listed below, as well as some multi-media resources. Patient care stories are a powerful and effective tool used for buy-in, especially when they highlight the critically important role frontline care providers play in early recognition and treatment. One recommended strategy in the education plan is to engage learners at the start of any training by playing videos or recounting stories of women impacted by sepsis.*

## Outline

1. Patient story
2. Sepsis incidence and mortality
    a. Brief overview of sepsis in adults, frequency, morbidity
    b. Worldwide frequency of maternal sepsis in the US
3. Key sepsis concepts
    a. Time is an issue: Early recognition is critical
    b. Overview of pathophysiology of sepsis (recommend Khan academy video)
    c. Vital sign abnormalities, (i.e. elevated temperature not need be present)
    d. Lab work
        i. Lactic acid
        ii. CBC and differential
        iii. Other labs
    e. Source control
    f. Early antibiotics
    g. Fluid resuscitation
    h. Fluid responsiveness
4. Maternal sepsis
    a. Pregnant women may look normal until they are very ill
    b. Routine adult sepsis screening protocols need to be altered to adjust for the physiologic changes of pregnancy
    c. Common sources of infection in the obstetric population
    d. Chorioamnionitis
5. Additional considerations
    a. Preeclampsia and fluid resuscitation
    b. Elevated lactic acid levels during labor
    c. Group A Strep- can have rapid onset

## Selected Course Resources:

1. Bauer ME, Lorenz RP, Bauer ST, et al. Maternal deaths due to sepsis in the state of Michigan, 1999-2006. 2015 Obstetrics & Gynecology, 126(4):747-725. doi:10.1097/AOG.0000000000001028
   - This article and associated appendix outlines the cases of women who died from sepsis during 1999-2006. Table 2 lists some of the vital sign or clinical indicator derangements present when the women came to the hospital with sepsis. This information helps to illustrate the importance of paying attention to respiratory rate and oxygen saturation, and shows that not all women present with a fever. The appendix provides details that can help in illustrating a patient story. The final paragraph in this article can be used to highlight key concepts related to the need for early identification and treatment.
2. Bauer ME, Balistreri M, MacEachern M. Normal range for maternal lactic acid during pregnancy and labor: A systematic review and meta-analysis of observational studies. 2018 Am J of Perinat, Advance online publication. doi:10.1055/s-0038-1675243
   - This article provides additional detail about lactic acid findings for patients pre- and post- delivery and during labor.
3. Carol J. Decker. Retrieved from https://www.caroljdecker.com
   - Carol Decker developed sepsis while pregnant with her second child and developed severe complications as a result of the infection. The site has video of her discussing her experience and her journey as she has recovered from sepsis and its complications.
4. Khan Academy. (2015). Septic shock pathophysiology. Retrieved from https://www.khanacademy.org/science/health-and-medicine/circulatory-system-diseases/shock/v/septic-shock-pathophysiology-and-symptoms
   - Khan Academy presents an engaging overview of the pathophysiology of sepsis. A suggestion is to pair the viewing of this video with a question and answer session with participants. Asking questions such as, “What would you expect to see in your patient with sepsis?” and “What might be a late sign?” allows for recall and retention of the concepts.
5. Olvera L, & Dutra L. Early recognition and management of maternal sepsis. 2016 Nurs for Women’s Health, 20(2):184-196. doi:10.1016/j.nwh.2016.02.003.
   - This article outlines a program for maternal sepsis early recognition and treatment. There is a video link embedded in this article: http://bcove.me/k8cl9d8j. The first 12 minutes of the video provide a vivid description of a clinical scenario where a patient died from sepsis. Maternity nurses may strongly resonate with this material.
6. World Sepsis Day. Retrieved from https://www.worldsepsisday.org/
   - This site contains patient stories, free materials for patient and staff education, and ideas about ways to celebrate World Sepsis Day.

*This education outline can be adapted for all maternity practitioners and providers, including but not limited to, scrub techs, delivery techs, CNAs, etc., and department educational competencies.

# Appendix L

## Lactation Safety of Antimicrobials Used for Treatment of Sepsis

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CMQCC acknowledges Dr. Phillip Anderson, MD, UCSD, and co-author of LactMed for his review and comments of the content of this appendix document.

For detailed information on the safety and use of antibiotics during pregnancy, we recommend the publicly accessible database LactMed.

With use of many antibiotics, there can occasionally be disruption of the infant's gastrointestinal and oral flora, resulting in diarrhea or thrush candidiasis.

## Safety Summary of Medications for Use During Lactation

| *Medication* | *Breastfeeding category* | Comments (taken directly from https://toxnet.nlm.nih.gov) |
|---|---|---|
| Ampicillin | Safe | |
| Ampicillin-sulbactam | Likely safe (but limited information) | |
| Azithromycin | Safe | |
| Aztreonam | Likely safe (but limited information) | |
| Caspofungin | No information | No information is available on the clinical use of caspofungin during breastfeeding. Caspofungin is indicated for use in infants over 3 months of age and it is poorly absorbed orally, so it is not likely to reach the bloodstream of the infant or cause any adverse effects in breastfed infants. However, no published experience exists with caspofungin during breastfeeding, therefore an alternate drug may be preferred especially while nursing a newborn or preterm infant. |
| Cefazolin | Likely safe (but limited information) | |
| Cefepime | Likely safe (but limited information) | |
| Cefotetan | Safe | |
| Cefoxitin | Safe | |
| Ceftriaxone | Likely safe (but limited information) | |
| Clindamycin | **Concern – use should be individualized** | **Clindamycin** has the potential to cause adverse effects on the breastfed infant's gastrointestinal flora. If oral or intravenous **clindamycin** is required by a nursing mother, it is not a reason to discontinue breastfeeding, but an alternate drug may be preferred. Monitor the infant for possible effects on the gastrointestinal flora, such as diarrhea, candidiasis (thrush, diaper rash) or rarely, blood in the stool indicating possible antibiotic-associated colitis. |
| Daptomycin | Likely safe (but limited information) | Limited and somewhat inconsistent information indicates that **daptomycin** produces very low levels in milk and it would not be expected to cause any adverse effects in breastfed infants. No special precautions are required. |
| Doripenem | No information | |

# Appendix L
## Lactation Safety of Antimicrobials Used for Treatment of Sepsis

| *Medication* | *Breastfeeding category* | Comments (taken directly from https://toxnet.nlm.nih.gov) |
|---|---|---|
| Doxycycline | **Contraindicated** | A number of reviews have stated that tetracyclines are contraindicated during breastfeeding because of possible staining of infants' dental enamel or bone deposition of tetracyclines. However, a close examination of available literature indicates that there is not likely to be harm in short-term use of **doxycycline** during lactation because milk levels are low and absorption by the infant is inhibited by the calcium in breastmilk. Short-term use of **doxycycline** is acceptable in nursing mothers. As a theoretical precaution, avoid prolonged or repeat courses during nursing. Monitor the infant for rash and for possible effects on the gastrointestinal flora, such as diarrhea or candidiasis (thrush, diaper rash). |
| Ertapenem | Likely safe (but limited information) | |
| Gentamicin | Likely safe (but limited information) | **Gentamicin** is poorly excreted into breastmilk. Newborn infants apparently absorb small amounts of **gentamicin**, but serum levels with typical three times/day dosages are far below those attained when treating newborn infections and systemic effects of **gentamicin** are unlikely. Older infants would be expected to absorb even less **gentamicin**. Because there is little variability in the milk **gentamicin** levels during multiple daily dose regimens, timing breastfeeding with respect to the dose is of little or no benefit in reducing infant exposure. Data are not available with single daily dose regimens. Monitor the infant for possible effects on the gastrointestinal flora, such as diarrhea, candidiasis (e.g., thrush, diaper rash) or rarely, blood in the stool indicating possible antibiotic-associated colitis. |
| Imipenem | Likely safe (but limited information) | |
| Linezolid | No information | **Linezolid** is excreted into breastmilk in concentration likely to be effective against staphylococcal strains found in mastitis. Limited data indicate that the maximum dose an infant would receive through breastmilk would be much less than the standard infant dose and that resulting infant serum levels are trivial.<br><br>If **linezolid** is required by the mother, it is not a reason to discontinue breastfeeding. Monitor the infant for possible effects on the gastrointestinal tract, such as diarrhea, vomiting, and candidiasis (e.g., thrush, diaper rash). However, because there is no published experience with **linezolid** during breastfeeding, an alternate drug may be preferred, especially while nursing a newborn or preterm infant. |
| Meropenem | No information (but others in same class safe) | Although no information is available on the use of **meropenem** during breastfeeding, milk levels appear to be low and beta-lactams are generally not expected to cause adverse effects in breastfed infants. Occasionally disruption of the infant's gastrointestinal flora, resulting in diarrhea or candidiasis have been reported with beta-lactams, but these effects have not been adequately evaluated. Vaborbactam, which is available in the combination product Vabomere, has not been studied in nursing mothers, but the combination is expected to have similar concerns as with **meropenem** alone. |

# Appendix L

## Lactation Safety of Antimicrobials Used for Treatment of Sepsis

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| *Medication* | *Breastfeeding category* | Comments (taken directly from https://toxnet.nlm.nih.gov) |
|---|---|---|
| Metronidazole | **Opinions vary about the use during breastfeeding** | With maternal intravenous and oral therapy, breastfed infants receive **metronidazole** in doses that are less than those used to treat infections in infants, although the active metabolite adds to the total infant exposure. Plasma levels of the drug and metabolite are measurable, but less than maternal plasma levels. Case reports of candidal infections and diarrhea have been reported, and a comparative trial suggested that oral and rectal colonization with *Candida* might be more common in infants exposed to **metronidazole**.<br><br>Because of the well demonstrated genotoxicity and mutagenicity in bacteria, carcinogenicity in animals, and possible mutagenicity in humans, concern has been raised about exposure of healthy infants to **metronidazole** via breastmilk. The relevance of these findings has been questioned and no definitive study has yet been performed in humans.<br><br>Opinions vary among experts on the advisability of using **metronidazole** during longer-term therapy while breastfeeding, but some sources recommend discontinuing breastfeeding for 12 to 24 hours after single-dose maternal treatment. Other drugs are available for some conditions that **metronidazole** is used to treat. |
| Oseltamivir | Likely safe (but limited information) | |
| Penicillin | Likely safe (but limited information) | |
| Piperacillin/tazobactam | Likely safe (but limited information) | Limited information indicates that piperacillin produces low levels in milk that are not expected to cause adverse effects in breastfed infants. Tazobactam has not been studied in nursing mothers. Occasionally disruption of the infant's gastrointestinal flora, resulting in diarrhea or candidiasis, have been reported with penicillins, but these effects have not been adequately evaluated. |
| Vancomycin | Likely safe (but limited information) | Limited information indicates that **vancomycin** produces low levels in milk and because **vancomycin** is poorly absorbed orally, it is not likely to reach the bloodstream of the infant or cause any adverse effects in breastfed infants. No special precautions are required. |

| | | |
|---|---|---|
| **OB SEPSIS (11532)** | | |
| Sepsis and the systemic inflammatory response syndrome: Definitions, epidemiology, and prognosis | | |
| | | |
| **GENERAL** | | |
| **Vital Signs** | | Routine, AS SPECIFIED |
| | | O2Sats and P continuous, BP, T, R Q30 min from time of postiive sepsis screen |
| | | Limb(s): |
| | | Special Instructions: |
| Pulse Oximetry | | Routine, CONTINUOUS |
| | | Special Instructions: |
| | | Alarm Setting: |
| | | Low Setting: |
| **Assessments** | | |
| Intake and Output | | Routine, CONTINUOUS |
| | | Specify: Strict |
| Cardiac Monitoring: | | Routine, CONTINUOUS |
| | | Requires cardiac monitoring when leaving the floor: |
| | | Yes |
| **Notifications** | | |
| Notify Provider for Vital Sign Parameters | | |
| | | Decrease in SBP greater than 40 mm HG from baseline |
| | | MAP less than or equal to 65 mm HG |
| | | Temperature less than 36 degrees C |
| | | White blood cells greater than 15,000 or less than 4,000 OR > 10% immature neutrophils |
| | | Glucose greater than 180 mg/dl in absence of diabetes |
| | | Patient has altered mental status |
| | | Urine output less than 0.5 ml/kg/hour (for 2 hours) |
| | | Creatinine greater than 1.2 OR doubling of creatinine |
| | | Notify Provider: |
| | | Systolic blood pressure greater than: |
| | | Systolic blood pressure less than: 85 |
| | | Diastolic blood pressure greater than: |
| | | Diastolic blood pressure less than: |
| | | Heart rate greater than: 110 |
| | | Heart rate less than: |
| | | Respiratory rate greater than: 24 |
| | | Respiratory rate less than: |
| | | Temperature greater than: 38 degrees C |
| | | SPO2 less than: 92 |
| | | SPO2 less than (specify): |
| | | Urinary output less than: |
| Notify physician if lactic acid value is greater than 2 or if it is higher than previous measurement | | Routine, ONE TIME |
| | | Notify Provider: |
| | | Notify physician if lactic acid value is greater than 2 or if it is higher than previous measurement |
| Call Rapid Response team or designated Sepsis team if SBP is less than 85 mm Hg | | Routine, CONTINUOUS |
| | | What is the nursing communication order: Call Rapid Response team if SBP is less than 85 mm Hg |
| Notify physician if conditions outlined in comments occur | | Routine, ONE TIME |
| | | Notify Provider: |
| | | Notify admitting physician of the following:*** |

| | | |
|---|---|---|
| **Interventions/Precautions** | | |
| Insert Straight Urinary Catheter if unable to void within 30 minutes | | Routine, AS SPECIFIED |
| | | Specify Cather: insert straight urinary catheter |
| | | Irrigate with: |
| | | Irrigation frequency: |
| | | Volume: |
| | | PRN Reason: if unable to void within 30 minutes |
| | | Continuous bladder irrigation: |
| | | Other instructions: |
| | | Discontinue: Per algorithm criteria |
| | | Reason for continued Catheter use: |
| | | Irrigate PRN Reason: |
| | | Discontinue: |
| **VASCULAR ACCESS/IV FLUIDS** | | |
| **Insertion/Management of Line(s)** | | |
| Insert and manage peripheral IV: Establish 2 peripheral 18 gauge IV catheters if no central line in place | | Routine, PRN |
| | | Establish 2 peripheral 18 gauge IV catheters if no central line in place |
| | | Specify Gauge: 18 G |
| **IV Fluids - Bolus** | | |
| NaCl 0.9% (FOR BOLUS ONLY) IV Soln | | 1,000 mL, intravenous, STAT for 1 doses, for 45 minutes |
| NaCl 0.9% (FOR BOLUS ONLY) IV Soln | | 30 mL/kg/dose, intravenous, ONCE PRN for 1 doses, for 60 minutes, other see Administration instructions |
| | | Instructions |
| | | Start bolus if SBP is less than 85 mm Hg or lactic acid is over 3.9. Notify attending physician immediately after starting bolus. 30ml/kg is to include any fluid given in the last 2 hours. Use pressure bag for administration |
| NaCl 0.9% (FOR BOLUS ONLY) IV Soln | | 30 mL/kg/dose, intravenous, ONCE PRN for 1 doses, for 180 minutes, other see Administration instructions |
| | | Start if lactic acid is between 2.0-3.9. Notify attending physician immediately after starting infusion. 30ml/kg is to include any fluid given in the last 2 hours. |
| Lactated ringers (FOR BOLUS ONLY) IV Soln | | 1,000 mL, intravenous, STAT for 1 doses |
| Lactated ringers (FOR BOLUS ONLY) IV Soln | | 30mL/kg/dose, intravenous, ONCE PRN for 1 doses, for 60 minutes, other see Administration instructions |
| | | Start bolus if SBP is less than 90 mm Hg or lactic acid is over 3.9. Notify attending physician immediately after starting bolus. 30mL/kg is to include any fluid given in the last 2 hours. Use pressure bag for administration. |
| **IV Fluids** | | |
| NaCl 0.45% IV Soln | | at 100 mL/hr, intravenous, CONTINUOUS |
| NaCl 0.9% IV Soln | | at 100 mL/hr, intravenous, CONTINUOUS |
| Lactated ringers IV Soln | | at 100 mL/hr, intravenous, CONTINUOUS |

| MEDICATIONS: ANTI-INFECTIVES | | |
|---|---|---|
| Sepsis | | |
| Severe allergies to beta-lactams are defined as anaphylaxis, angioedema, bronchospasm or hives within 60 minutes of a dose, or penicillin induced Stevens Johnson Syndrome or Toxic epidermal necrolysis. Without one of these complications from a penicillin, the risk of an allergic reaction to a cephalosporin is about 1:1000 i.e. 0.1%. | | |
| Sepsis related to Chorioamnionitis (ampicillin + gentamicin + clindamycin) | | |
| If postpartum, GBS colonized, and patient received prophylactic penicillin, consider | | |
| An alternative to ampicillin/gentamicin is cefoxitin. If patient proceeds to cesarean delivery, | | |
| Vancomycin + Gentamicin are a suitable substitute for Ampicillin for patients with PCN allergy | | |
| Gentamicin may also be dosed at 5mg/kg q24 hours. | | |
| Ampicillin 2,000mg in 0.9% naCl 100mL IVPB (minibag) | | 2,000 mg, intravenous, Q6HR, for 20 minutes |
| | | To administer 6 hours after initial dose |
| | | Activate before infusing |
| Gentamicin custom IVPB | | 1.5 mg/kg/dose, intravenous, Q8HR, for 30 minutes |
| | | To administer 8 hours after initial dose. |
| | | Refrigerate or store at room temperature |
| | | **BLACK BOX WARNING** |
| *gentamicin Pharmacy dosing order | | Communication |
| cefoxitin (MEFOXIN) 2000 mg in 0.9% nACl 100 mL IVPB (minibag) | | 2,000 mg, intravenous, Q6HR, for 60 minutes |
| | | Not recommended if know to be GBS positive |
| | | To administer 6 hours after initial dose. |
| | | Activate before infusing |
| Clindamycin (CLEOCIN) 900mg in DSW IVPB (premix) | | 900 mg, intravenous, Q8HR for 60 minutes |
| | | To administer 8 hours after initial dose |
| | | **BLACK BOX WARNING** |
| metroNIZADOLE (FLAGYL) 500 mg in 0.79% NaCl 100mL (premix) | | 500 mg, intravenous, Q8HR, for 60 minutes |
| | | To administer 8 hours after initial dose |
| | | Do NOT refrigerate - avoid alcohol containing products |
| | | **BLACK BOX WARNING** |
| vancomycin inj | | 20 mg/kg/dose, intravenous, Q8HR |
| | | Can replace ampicillin if immediate hypersensitivity reaction to PCN |
| | | To administer 8 hours after initial dose |
| *vancomycin Pharmacy dosing order | | Communication |
| Sepsis related to Chorioamnionitis (clindamycin + cefoxitin) | | |
| If postpartum, GBS colonized, and patient received prophylactic penicillin, consider | | |
| An alternative to ampicillin/gentamicin is cefoxitin. If patient proceeds to cesarean delivery, add clindamycin to regimen. | | |
| Vancomycin + Gentamicin are a suitable substitute for ampicillin for patients with PCN allergy | | |
| Gentamicin may also be dosed at 5mg/kg q24 hours. | | |
| Ampicillin 2,000mg in 0.9% NaCl 100mL IVPB (minibag) | | 2,000 mg, intravenous, Q6hr, for 20 minutes |
| | | To administer 6 hours after initial dose |
| | | Activate before infusing |
| gentamicin custom IVPB | | 1.5 mg/kg/dose, intravenous, Q8hr, for 30 minutes |
| | | To administer 8 hours after initial dose |
| | | Refrigerate or store at room temperature |
| | | **BLACK BOX WARNING** |
| *gentamicin Pharmacy dosing order | | Communication |
| cefoxitin (MEFOXIN) 2000mg in 09% NaCl 100mL IVPB (minibag) | | 2,000 mg, intravenous, Q6hr, for 60 minutes |
| | | Not recommended if known to be GBS positive |
| | | To administer 6 hours after initial dose |
| | | Activate before infusing |

| | | |
|---|---|---|
| clindamycin (CLEOCIN) 900mg in DSW IVPB (premix) | | 900 mg, intravenous, Q8hr, for 60 minutes |
| | | To administer 8 hours after initial dose |
| | | **BLACK BOX WARNING** |
| metroNIDAZOLE (FLAGYL) 500mg 9n 0.79% NaCl 100mL (premix) | | 500 mg, intravenous, Q8hr, for 60 minutes to administer 8 hours after initial dose |
| | | Do NOT refrigerate - avoid alcohol containing products |
| | | **BLACK BOX WARNING** |
| vancomycin inj | | 20 mg/kg/dose, intravenous, Q8hr |
| | | Can replace ampicillin if immediate hypersensitivity reaction to PCN |
| | | To administer 8 hours after initial dose |
| *vancomycin Pharmacy dosing order | | Communication |
| Sepsis related to postpartum endometritis | | |
| If postpartum, GBS colonized and patient received prophylactic penicillin, consider | | |
| An alternative to ampicillin/gentamicin is cefoxitin. If patient proceeds to cesarean delivery, | | |
| Vancomycin + gentamicin are a suitable substitute for ampicillin for patients with PCN allergy | | |
| Gentamicin may also be dosed at 5mg/kg q24hours | | |
| Ampicillin, 2000mg in 0.9% NaCl 100mL/ IVPB (minibag) | | 2,000 mg, intravenous, Q6hr, for 20 minutes |
| | | To administer 6 hours after initial dose |
| | | Activate before infusing |
| gentamicin custom IVPB | | 1.5 mg/kg/dose, intravenous, Q8hr for 30 minutes |
| | | To administer 8 hours after initial dose |
| | | Refrigerate or store at room temperature |
| | | **BLACK BOX WARNING** |
| *gentamicin Pharmacy dosing order | | Communication |
| cefoxitin (MEFOXIN) 2000mg in 0.9% naCl 100mL IVPB (minibag) | | 2,000 mg, intravenous, Q6hr, for 60 minutes |
| | | Not recommended if known to be GBS positive |
| | | To administer 6 hours after initial dose |
| | | Activate before infusing |
| clindamycin (CLEOCIN) 900mg in DSW IVPB (premix) | | 900 mg, intravenous, Q8hr, for 60 minutes |
| | | To administer 8 hours after initial dose |
| | | **BLACK BOX WARNING** |
| metroNIDAZOLE (FLAGYL) 500mg n 0.79% naCl 100mL (premix) | | 500 mg, intravenous, Q8hr, for 60 minutes |
| | | To administer 8 hours after initial dose |
| | | Do NOT refrigerate - avoid alcohol containing products |
| | | **BLACK BOX WARNING** |
| vancomycin inj | | 20 mg/kg/dose, intravenous Q8hr |
| | | Can replace ampicillin if immediate hypersensitivity reaction to PCN |
| | | To administer 8 hours after initial dose |
| *vancomycin Pharmacy dosing order | | Communication |
| Sepsis related to pyelonephritis | | |
| cefTRIAXone (ROCEPHIN) 1g in 0.9% naCl 50mL IVPB (minibag) | | 1,000 mg, intravenous, Q24hr, for 30 minutes |
| | | For mild to moderate pyelonephritis |
| | | Activate before infusing - Do NOT infuse in the same IV lumen as calcium-containing solutions |
| ampicillin 2,000mg in 0.9% naCl 100mL IVPB (minibag) | | 2,000 mg, intravenous, Q6hr for 60 minutes |
| | | For mild to moderate pyelonephritis |
| | | Activate before infusing. Should be ordered with gentamicin. |

| | | |
|---|---|---|
| | | Activate before infusing. Should be ordered with gentamicin. |
| gentamicin in dextrose 5% 100mL IVPB | | 1.5 mg/kg/dose, intravenous, Q8hr for 60 minutes |
| | | For mild to moderate pyelonephritis |
| | | Should be ordered with ampicillin. Refrigerate or store at room temperature |
| | | **BLACK BOX WARNING** |
| *gentamicin Pharmacy dosing order | | For mild to moderate pyelonephritis |
| | | Should be ordered with ampicillin. Refrigerate or store at room temperature |
| | | **BLACK BOX WARNING** |
| | | Communication |
| aztreonam (AZACTAM) 1000 mg in 0.9% NaCl 50mL IVPB (minibag) | | 1,000 mg, intravenous, Q8hr for 30 minutes |
| | | For mild and moderate disease - only for severe penicillin allergy |
| | | Activate before infusing |
| piperacillin/tazobactam (ZOSYN) 3.375g in 0.9% NaCl 100mL IVPB (minibag) | | 3.375 g, intravenous Q6hr, for 30 minutes |
| | | For severe or complicated pyelonephritis. |
| | | Activate before infusing |
| For PCN allergy, consult to infectious diseases? | | Reason for consult: |
| | | Has the consulting physician been contacted? |
| | | STAT |
| Sepsis related to Community Acquired pneumonia (CAP) WITHOUT Pseudomonas | | |
| Risk factors | | |
| For patients with CAP admitted to medical ward, recommend ceftriaxone plus azithromycin | | |
| If MSRA suspected, recommend adding vancomycin | | |
| cefTRIAXone (ROCEPHIN) 1000 mg in 0.9% NaCl 50mL IVPB (minibag) | | 1,000 mg, intravenous Q24hr, for 30 minutes |
| azithromycin (ZITHROMAX) 500mg in 0.9% NaCl 250mL IVPB (VIAL-MATE) | | 500 mg, intravenous, Q24hr, for 60 minutes |
| vancomycin inj | | 1,000 mg, intravenous, Q12hr |
| vancomycin inj | | 20 mg/kg/dose, intravenous, Q12hr |
| vancomycin inj Pharmacy dosing order | | intravenous |
| Sepsis related to Community Acquired pneumonia (CAP) WITH Pseudomonas risk factors | | |
| Patients with CAP and Pseudomonas risk factors should be treated with double anti-pseydomonal coverage: cefepime or piperacillin/tazobactam ad tobramycin or gentamicin | | |
| High risk for Pseudomonas infection: | | |
| Bronchiectasis; or structural lung disease (chronic bronchitis, COPD, emphysema, interstitial lung disease, pulmonary fibrosis, restrictive lung disease) and repeated antibiotics or chronic systemic steroid use | | |
| If MRSA suspected, recommend adding vancomycin | | |
| piperacillin/tazobactam (ZOSYN) 4.5mg in 0.9% naCl 100mL IVPB (minibag) | | 4.5 g, intravenous, Q6hr, for 30 minutes |
| cefepime (MAXIPIME) inj | | 2,000 mg, intravenous, Q8hr, for 30 minutes |
| *tobramycin Pharmacy dosing order | | Communication |
| *gentamicin Pharmacy dosing order | | Communication |

| | | |
|---|---|---|
| OB Patients with sepsis with unknown etiology and/or currently on antibiotics | | |
| Severe allergies to beta-tactams are defined as anaphylaxis, angioedema, bronchospasm or hives within 60 minutes of a dose, or penicilin induced Stevens Johnson Syndrome or Toxi Epidermal Necrolysis (TEN). Without one of these complications from a penicillin, the risk of an allergic reaction to a cephalosporins is about 1:1000, i.e. 0.1% | | |
| Add vancomycin if indicated (e.g. known history of MRSA). Provider should discontinue any prior antibiotics. | | |
| cefepime (MAXIPIME) 2000mg in 0.9% NaCl 100mL IVPB (minibag) | | 2,000 mg, intravenous, Q8hr, for 30 minutes |
| | | For penicillin allergy. Should be ordered with metronidazole |
| | | To be administered 12 hours after initial dose |
| | | Activate before infusing |
| metroNIDAZOLE (FLAGYL) 500mg in 0.79% NaCl 100mL (premix) | | 500 mg, intravenous, Q8hr for 60 minutes |
| | | For penicillin allergy. Should be ordered with cefepime. Discontinue breastfeeding while receiving metronidazole, resume breastfeeding 24 hrs after the last dose |
| | | To be administered 8 hours after initial dose |
| | | Do NOT refrigerate - avoid alcohol containing products |
| | | **BLACK BOX WARNING** |
| piperacillin/tazobactam (ZOSYN) 3.375 in 0.9% NaCl 100mL IVPB (minibag) | | 3.375 g, intravenous, Q6hr, for 30 minutes |
| | | Administer 6 hours after initial dose |
| | | Activate before infusing |
| vancomycin IVPB | | 1,000 mg, intravenous, Q8hr |
| | | To administer 8 hours after initial dose |
| *vancomycin Pharmacy dosing order | | Communication |
| IMAGING AND OTHER DIAGNOSTICS | | |
| Ultrasound | | |
| US OB Detailed Single Fetus | | Routine |
| | | Portable? |
| | | Reason for Exam: |
| | | Is the patient pregnant? |
| | | Additional procedure instructions for imaging technologist: |
| | | 1 TIME IMAGING for 1 |
| US OB Detailed Additional Fetus | | Routine |
| | | Portable? |
| | | Reason for Exam: |
| | | Is the patient pregnant? |
| | | Additional procedure instructions for imaging technologist: |
| | | 1 TIME IMAGING for 1 |
| X-Ray | | |
| XR Chest 1 View Portable | | Routine |
| | | Portable? |
| | | Reason for Exam: |
| | | Reason for Exam: |
| | | Is the patient pregnant? |
| | | Additional procedure instructions for imaging technologist: |
| | | 1 TIME IMAGING for 1 |

| | | |
|---|---|---|
| MEDICATIONS: OTHER | | |
| Antipyretics | | |
| acetaminophen (TYLENOL) Adult Supp | | 325 mg, Rectal, Q4h PRN, other, temperature greater than 38C (100.4F) |
| LABS | | |
| Hematology | | |
| CBC with automated differential | | STAT, ONCE for 1 occurrences |
| Prothrombin Time/INR | | STAT, ONCE for 1 occurrences |
| Partial Thromboplastin Time | | STAT, ONCE for 1 occurrences |
| Chemistry | | |
| Blood gas, arterial | | STAT, ONCE for 1 occurrences |
| Comprehensive metabolic panel w/GFR | | STAT, ONCE for 1 occurrences |
| Basic metabolis panel w/GFR | | STAT, ONCE for 1 occurrences |
| Live panel (Hepatic) | | STAT, ONCE for 1 occurrences |
| RAPIDComm Blood Gas | | |
| Use these orders for RAPIDComm project labs if ordering from anywhere with SSR or Eden/Delta/Summit hospitals | | |
| Arterial blood gas | | STAT, ONE TIME for 1 occurrences |
| Venous blood gas | | STAT, ONE TIME for 1 occurrences |
| Capillary blood gas | | STAT, ONE TIME for 1 occurrences |
| | | Indication for test: Diagnostic Study |
| | | FiO2 - Liter Flow: Room Air |
| Umbilical cord blood gas | | STAT, ONE TIME for 1 occurrences |
| | | Indication for test: Diagnostic study |
| | | FiO2 - Liter Flow: Room Air |
| Microbiology | | |
| Culture, blood | | STAT, EVERY 1 MIN for 2 occurrences |
| | | 2 sets/2 sites. If patient has central line then draw from the line |
| Culture, placenta | | Routine, ONCE |
| Urine Studies (Single Response) | | |
| Urinalysis, macro with/ micro if indicated | | STAT, ONCE for 1 occurrences |
| Urinalysis & cult if indicated | | STAT, ONCE for 1 occurrences |
| Lactic acid (Single response) | | |
| Lactic acid - plasma | | STAT, NOW AND AFTER 3 HOURS for 2 occurrences |
| | | Repeat order to be cancelled if previous lactate result is <2: Yes |
| | | PRN Reason: |
| | | Draw Trough: |
| Blood Gas venous w/lactate | | STAT, NOW AND AFTER 3 HOURS for 2 occurrences |
| | | Repeat order to be cancelled if previous lactate result is <2: Yes |
| | | PRN Reason: |
| No lactate test ordered at this time | | Routine, ONE TIME for 1 occurrences |
| | | What is the nursing communication order: No lactate test ordered at this time |
| Amniocentesis Specimen | | |
| Gram Stain | | STAT, ONCE for 1 occurrences amniotic fluid |
| Glucose, fluid | | STAT, ONCE for 1 occurrences amniotic fluid |
| LDH, fluid | | STAT, ONCE for 1 occurrences |
| Culture, body fluid, Aer & anaer w/smea - amniotic fluid | | Routine, ONCE for 1 occurrences amniotic fluid culture |
| CONSULTS | | |
| **Provider** | | |
| Consult to infectious diseases | | Reason for consult: |
| | | Has the consulting physician been contacted? |
| | | STAT |
| Consult to neonatology or pediatrician | | Reason for consult: Presence of infection, and treatment |
| | | Has the consulting physician been contacted? |
| | | Routine |
| Consult to Maternal/Fetal Medicine: | | Reason for consult: |
| | | Has the consulting physician been contacted? |
| | | Routine |
| | | |