

Quality Improvement Opportunities Identified Through Case Review of Pregnancy-Related Deaths From Sepsis

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ABSTRACT

Objective: To analyze quality improvement opportunities (QIOs) identified through review of cases of maternal death from sepsis by the California Pregnancy-Associated Mortality Review Committee.

Design: Qualitative descriptive design using thematic analysis.

Sample: A total of 118 QIOs identified from 27 cases of pregnancy-related deaths from sepsis in California from 2002 to 2007.

Methods: We coded and thematically organized the 118 QIOs using three of the four domains commonly applied in quality improvement initiatives for maternal health care: *Readiness*, *Recognition*, and *Response*. Data did not include reporting issues, so the *Reporting* domain was excluded from the analysis.

Results: Women's delay in seeking care was the central theme in the *Readiness* domain. In the *Recognition* domain, health care providers missed the signs and symptoms of sepsis, including elevated temperature, elevated white blood cell count, increased heart rate, decreased blood pressure, mottled skin, preterm labor, headache, and pain. For *Response*, late antibiotic administration was a central theme; multiple emergent themes included administration of the wrong antibiotics, failure to investigate women's complaints of pain, lack of nurse/provider communication, and lack of follow-up care after hospital discharge.

Conclusion: To reverse the contribution of sepsis to the rising rate of maternal mortality in the United States, health care facilities and providers need to reduce barriers for women who seek care, recognize early symptoms, and respond with appropriate treatment. This could be achieved by implementation of the Maternal Early Warning Criteria, standardized guidelines such as those from the Surviving Sepsis campaign, and comprehensive discharge education.

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Sepsis is one of the five leading causes of maternal mortality around the world (Acosta & Knight, 2013; Al-Ostad, Kezouh, Spence, & Abenhaim, 2015; Buddeberg & Aveling, 2015). Recently, rising rates of maternal mortality from sepsis have been reported in developed nations, including Ireland (Knowles, O'Sullivan, Meenan, Hanniffy, & Robson, 2014) and the United States (Kuriya et al., 2016). In the United Kingdom, maternal death from sepsis has been one of the leading causes of pregnancy-related death (McIntosh, 2011) and is the focus of an ongoing report, *Saving Lives, Improving Mothers' Care* (Knight et al. 2014, 2017). In their population-based cohort study in California, Acosta et al. (2013) noted that the rate of severe maternal sepsis was approximately twice that of the estimated national rate.

Early diagnosis and treatment are vital to reduce morbidity and improve survival from maternal sepsis (Acosta & Knight, 2013; Bauer, Lorenz, Bauer, Rao, & Anderson, 2015; Galvao, Braga, Goncalves, Guimaraes, & Barga, 2016; McIntosh, 2011). Sepsis has garnered worldwide attention in recent years, as evidenced by the Surviving Sepsis campaign (Survivingsepsis.org, 2016), which began in 2002 with the goal of the reduction of mortality from sepsis by 25%. The campaign is focused on seven key elements: building awareness of sepsis, improving diagnosis, increasing the use of appropriate treatment, educating health care professionals, improving post-ICU care, developing guidelines for care, and implementing a performance improvement program. By 2005, guidelines were established, and a manual for how

to initiate the campaign in hospitals was publicly available. In 2013, U.S. regulatory agencies adopted the guidelines as mandated measures ([Survivingsepsis.org, 2016](#)). The most current version (4th edition) of the guidelines for the management of severe sepsis and septic shock is available on the Surviving Sepsis Web site ([Survivingsepsis.org, 2016](#)).

Sepsis is defined as the presence of an infection associated with systemic involvement ([Galvao et al., 2016](#)). Fluctuations and unique complexities in the maternal immune system over the pregnancy and postpartum periods leave women more vulnerable to infection ([Acosta et al., 2013](#); [Mor & Cardenas, 2010](#)). In a U.K. population-based study, researchers identified factors associated with sepsis: being Black or of another non-White racial/ethnic group; primiparous; pre-existing medical problem, febrile illness, or antibiotic use in the 2 weeks before birth; operative vaginal birth; cesarean birth; or birth complication ([Acosta et al., 2014](#)). In a U.S. population-based cohort study, associated factors included socioeconomic disparities and known clinical risk factors, public or no insurance, racial and ethnic minority status, low hospital birth volume, diabetes, and hypertension ([Acosta et al., 2013](#)).

Despite the rise in the rate of maternal mortality from sepsis, the Surviving Sepsis campaign guidelines have not been implemented in perinatal populations ([Olvera & Dutra, 2016](#)). In the United Kingdom, the U.K. Sepsis Trust released six clinical toolkits specifically for women in pregnancy ([U.K. Sepsis Trust, n.d.](#)) and the National Health System Education Scotland produced a *Maternal Sepsis e-Learning Package* in response to the rising rates of maternal sepsis in 2006 to 2008 ([Scottish Multiprofessional Maternity Development Programme, 2019](#)). In the United States, maternity care providers' resistance to the adoption of sepsis guidelines is largely because of the absence of protocols that address the unique condition of pregnancy and the fact that treatments deemed safe and effective from general patient studies may not be safe for fetal or maternal health. General guidelines fail to account for normal physiologic changes in pregnancy that can mimic the signs of sepsis ([Acosta et al., 2013](#); [Olvera & Dutra, 2016](#)). For example, increased heart rate, respiratory rate, and white blood cell counts are all elements of systemic inflammatory response syndrome, except during normal pregnancy, when all three signs and symptoms are normally elevated. No validated sepsis scoring

system has yet been developed that accounts for the normal physiologic changes that occur in pregnant women ([Albright, Ali, Lopes, Rouse, & Anderson, 2014](#); [Olvera & Dutra, 2016](#)).

Sepsis was the fifth-leading cause of pregnancy-related death in California during a 6-year period (2002–2007). The California Pregnancy-Associated Mortality Review (CA-PAMR) committee chose to examine quality improvement opportunities (QIOs) for sepsis cases because the chance to alter outcomes was classified as strong or good in nearly two thirds of these deaths ($n = 17$ of 27). The purpose of our study was to examine QIOs among pregnancy-related deaths caused by sepsis to identify themes that could inform and guide changes in obstetric practice to reduce preventable maternal morbidity and mortality.

Methods

Design, Setting, and Analytic Approach

The study design and thematic analysis were based on three of the four domains commonly applied in quality improvement initiatives for maternal health care: *Readiness*, *Recognition*, and *Response*. QIO data did not include reporting issues, so the *Reporting* domain was excluded from the analysis. These domains were introduced in the first version of the *Obstetric Hemorrhage Toolkit* published by the California Maternal Quality Care Collaborative ([Lyndon et al., 2010](#)). They have since been widely adopted, most notably in the patient safety bundles published by the National Partnership for Maternal Safety ([Council on Patient Safety in Women's Health Care, 2019](#)). In this series, we refer to the domains collectively as the *4R Framework*. Further details regarding the methodology for our study are described in the introductory article to this series ([Morton, VanOtterloo, Seacrist, & Main, 2019](#)).

Sample

The sample included 118 QIOs from the CA-PAMR committee's analysis of 27 cases of pregnancy-related mortality from sepsis from 2002 through 2007 in California. These cases were identified from the CA-PAMR data set described elsewhere ([Morton et al., 2019](#)). The QIO data were derived from committee members' open-ended responses to the following question: *In this particular case, what alternative approaches to recognition, diagnosis, treatment, or follow-up at the system, provider, and/or patient levels may have led to better patient care and/or a better outcome?*

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Table 1: Themes Related to the 4R Framework, Quality Improvement Opportunities, and Recommendations Related to Maternal Sepsis

Themes	Quality Improvement Opportunities	Recommendations
<i>Readiness</i>		
<i>Women's Knowledge</i>	Delay in seeking care ^a Better discharge teaching Education for women regarding postpartum complications and when to seek medical attention	Prenatal and discharge teaching including effective communication with women and families regarding risk, risk reduction, presence of symptoms, and when to seek immediate care
<i>Clinician Knowledge</i>	Lack of consultation Lack of availability of trained personnel for intubation Lack of thorough history/assessment	Institute policies for consultation Train and schedule personnel to cover all shifts and all emergencies Obtain recent history from family members when women unable to communicate.
<i>Facility Preparation</i>	Location of care Inadequate staffing	If a woman presents to the emergency department during pregnancy or the postpartum period, she should be seen by an obstetric clinician Clinically unstable women should be cared for in ICU rather than postpartum unit, with labor and birth nurse collaboration Need better systems of medical record integration across facilities Follow AWHONN staffing guidelines ^b Assure availability of appropriately trained personnel for all emergencies and operating room staff
<i>Recognition</i>		
<i>Missed Signs and Symptoms</i>	Recognize early signs and symptoms of complications ^a More aggressive investigation of source of infection was needed Did not appreciate how sick the woman was	Recognize signs and symptoms of sepsis • Pain • Elevated temperature • Elevated white blood counts • Elevated heart rate • Low blood pressure • Mottled skin • Preterm labor • Headache Perform thorough assessments when any symptoms of sepsis are evident
<i>Misdiagnosis</i>	Misdiagnosis of drug-seeking behaviors	Perform thorough assessments when any symptoms of sepsis are evident, even when pain is the only symptom present

(Continued)

Table 1: Continued

Themes	Quality Improvement Opportunities	Recommendations
<i>Response</i>		
<i>Timing of Treatment</i>	Delay in antibiotics administration	Start antibiotics sooner
<i>Inadequate Treatment</i>	Inappropriate dosage and coverage of antibiotics	Administer appropriate antibiotics
	Treated generously with pain medications instead of investigating cause of pain	Investigate pain source
<i>Care Coordination</i>	Lack of continuity of care. High-risk woman using the emergency department for primary care	Increase use of consultations (maternal fetal medicine, internal medicine, surgery), especially when women are being assessed and cared for in departments other than obstetrics (such as emergency)
	Nurse should feel empowered to insist on obstetric examination of the perineum	Nurse empowerment for communication and escalating communication when needed
<i>Follow-Up Care</i>	Woman was discharged without appropriate assessment of perineal infection	Need sooner follow-up appointment or home health visit for women at risk of sepsis or with symptoms of sepsis

Note. The 4R Framework includes the four domains first identified by Lyndon et al. (2010): *Readiness, Recognition, Response, and Reporting*. Data did not include *Reporting* issues, so that domain was excluded from the analysis. Quality improvement opportunities were identified by the California Pregnancy-Associated Mortality Review Committee.

^aIndicates the most frequently cited quality improvement opportunities. ^bAssociation of Women's Health, Obstetric and Neonatal Nurses (2011).

Results

Characteristics of Women Who Died of Sepsis in California

Of the 333 pregnancy-related deaths that occurred from 2002 to 2007 in California, sepsis accounted for 8% ($n = 27$), and the overall pregnancy-related sepsis mortality rate was 0.8/100,000 live births (California Department of Public Health [CDPH], 2018). Fifteen sepsis deaths (56%) occurred among women younger than 30 years. Fourteen of the women who died of sepsis (52%) were nulliparous, and 17 (63%) had adequate prenatal care. Seventeen of the women who died (63%) were insured by MediCal, eight (30%) had private insurance, and two (7%) were uninsured or their insurance status was unknown (CDPH, 2018).

Nearly half of the women who died of sepsis were Hispanic ($n = 13$, 48%); of these, eight were born in the United States, and five were born elsewhere. The remaining women were White ($n = 6$, 22%), Black ($n = 2$, 7%), and other ($n = 6$, 22%). Women who died of sepsis were more likely to experience preterm birth than the general population of women

who gave birth in California during this time. Of the women who died of sepsis, six (23%) gave birth at less than 32 weeks gestation, eight (31%) gave birth between 32 and 36 weeks gestation, and 12 (46%) gave birth at 37 weeks gestation or greater. Of the women who died of sepsis, 17 (64%) had identified pregnancy risk factors when they entered prenatal care, and 24 (89%) had identified risk factors when they entered the hospital for labor and childbirth. Two thirds of the women who died of sepsis ($n = 18$) had vaginal births. The mean time between the birth and the woman's death was 6.9 days; the median was 2 days postpartum (CDPH, 2018). Despite the high-risk status of the women who died of sepsis, 25 of the 27 deaths were deemed potentially preventable. In 17 (63%) cases, there was a good to strong chance that the outcome could have been altered, and in 8 (30%), there was some chance that the outcome could have been altered (CDPH, 2018).

No single organism or site of infection contributed to the majority of sepsis deaths. Numerous bacterial or viral organisms from a variety of sources were involved, and endometritis accounted for the

greatest number: six (22%) of the cases. Necroses (necrotizing fasciitis, placental, colon, and episiotomy) accounted for five cases. Infections such as chorioamnionitis, coccidioidomycosis, peritonitis, and pyelonephritis accounted for two or three cases each; cryptococcal meningitis, Group A *Streptococcus* species, pelvic inflammatory shock, and villitis (infection of the chorionic villi) accounted for one case each.

Relationships of QIOs to 4R Framework

Three domains (*Readiness*, *Recognition*, and *Response*) of the 4R Framework were used to categorize the themes extracted from the QIO data collected from pregnancy-related sepsis mortality case review. The goals for the project and for this analysis were to affirm and contribute to current and future action recommendations for quality-of-care improvement to prevent women's deaths from sepsis. The themes, QIOs, and action recommendations for each domain are summarized in Table 1. No QIO themes were specific to the *Reporting* domain.

Readiness Domain

Readiness, or the preparation required to respond to a situation or need appropriately, is vital to providing safe and effective care for pregnant women and women during the postpartum period.

Women's Knowledge. Among the 39 QIOs in the *Readiness* domain, one theme emerged as predominant and centered on women's lack of knowledge and understanding about the significance of symptoms that warrant clinical attention. Many of the women who died of sepsis reported symptoms of illness for several days before they sought care. As a result, they arrived to the hospital in advanced stages of illness. Three possible explanations for delay in seeking care included the following: (a) women felt too ill to leave home to seek care; (b) women were unaware of the signs and symptoms of illness, specifically sepsis, and when to seek care; and (c) women recognized the severity of the illness but did not seek care for a variety of reasons, including barriers to access.

QIOs related to women's lack of knowledge that could have been addressed during the birth hospitalization identified by the CA-PAMR committee included "better discharge teaching" and "education for women regarding postpartum complications and when to seek medical attention." The committee members described women's behavior

Many women who died of sepsis during pregnancy or the postpartum period reported symptoms for several days.

through observations such as "Woman was non-compliant and in denial about her diabetes" or "Woman had been sick for a while and didn't come in." With no information about the context and constraints in women's lives, the committee members recognized the critical role of maternity care providers in educating women and their family members about specific risk factors, symptoms, and treatment recommendations for sepsis. They also acknowledged women's autonomy and responsibility in decisions regarding their health and well-being. Committee assessments were based on the strong likelihood that women and their families did not receive adequate instruction about what signs and symptoms should warrant medical attention after discharge.

Clinician Knowledge. Although women's knowledge about risk factors and worrisome symptoms was the main theme in the *Readiness* domain, inadequate *Clinician Knowledge* was another key theme. QIOs pointed to suboptimal supervision, and committee members noted "family practice scope-of-practice issues," "lack of consultation," and the "lack of availability of trained personnel for intubation" as factors that likely contributed to death. In cases in which women presented to care but were unable to communicate, clinicians needed to immediately obtain histories from family members, including pregnancy and/or postpartum status.

Facility Preparation. Facility readiness was deficient in several cases, and gaps in care indicated the likely lack of protocols to specify the best location and appropriate clinical consultation among obstetric and intensive care specialists to assess, diagnose, and treat possible infection in the postpartum period. For example, one woman was seen in the emergency department (ED) several days postpartum; despite being febrile and tachycardic, she was not evaluated by an obstetrician before she was discharged home, and she subsequently died. Women who sought care through EDs were discharged only to return within a day or two in septic shock. Within the theme of *Facility Preparation*, the location and continuity of care were significant. When women were taken to hospitals other than their birth facilities that had limited or no access to their prenatal care records, significant gaps in continuity of care

Lack of assessment and recognition were identified as key contributors to pregnancy-related deaths caused by sepsis.

occurred: "Lack of continuity of care. Social worker/case management intervention would have been helpful in high-risk woman using ER [emergency room] for primary care." Other issues related to the location of care included care in departments other than the intensive care unit, overall lack of continuity of care because of multiple locations, inappropriate transfers, and lack of integration of medical records. Inadequate staffing was a possible factor when nurses were not available to accompany women: "lower nurse staffing at night might be a contributing factor."

Recognition Domain

Although the infectious agents identified among the women who died of sepsis were diverse, there were common themes among the 28 QIOs related to *Recognition*, including *Missed Signs and Symptoms* of an infectious process or clinical deterioration and *Misdiagnosis*.

Missed Signs and Symptoms. Inability or failure of clinicians to recognize signs and symptoms of possible infection was evident in the QIO data. Although the medical record summaries confirmed delays in the recognition of signs and symptoms, the underlying reasons for this gap could only be inferred. Common signs and symptoms that were not recognized as critical included elevated temperature, elevated white blood cell count, increased heart rate, decreased blood pressure, mottled skin, preterm labor, and headache: ". . . recognize early signs of complication." Full assessments were not provided, "More aggressive investigation of source of infection was needed," and the committee determined that this would have resulted in improved recognition of complications. The significance of abnormal vital signs was frequently missed in clinical assessments, although they were noted in the medical records and indicated possible sepsis long before clinicians recognized the extent of deterioration: "Abnormal vital signs" and "Missed opportunity to pick up woman's deterioration over a period of 17 hours. Nurses may have missed infection warning signs (high temp[erature]) and/or not communicated woman's deterioration to physician (who was off site)."

Although a known symptom of sepsis, severe pain was overlooked by clinicians as a potential sepsis indicator: "Failure to act on repeated complaints of abdominal pain (multiple visits to labor and delivery triage) overlooked potential nonobstetric causes of abdominal pain leading to delay in diagnosis." Another committee observation highlighted the issue of underinvestigation: "Missed trigger of pain requiring treatment with Vicodin, but no diagnosis of underlying cause." In addition to the lack of attention to pain as a symptom, some women's complaints of pain were disregarded by clinicians who assumed that they were seeking drugs: ". . . presumption of drug-seeking behavior" and "possible undertreatment due to psychiatric history and behaviors." In these instances, bias among clinicians influenced the recognition of abnormal signs and symptoms in women during pregnancy or the postpartum period.

Misdiagnosis. In cases in which clinical warning signs that required prompt attention were not recognized, there was a corresponding lack of clinical reasoning and correct diagnosis of the condition. Despite the fact that women had fever, bleeding, pain, and other symptoms, clinicians seemed not to ". . . appreciate how sick the woman was" and missed opportunities to thoroughly investigate and make timely diagnoses. When women's symptoms were mistakenly attributed to behavioral aberrations, undertreatment or inappropriate treatment followed and resulted in preventable death.

Response Domain

When conditions such as maternal sepsis are not recognized and diagnosed in a timely way, the facility and clinician response becomes too little, too late. Most QIOs among the sepsis deaths were classified in the *Response* domain ($n = 71$). Lack of assessment and recognition were identified as key contributors to pregnancy-related deaths caused by sepsis. The key themes in the *Response* domain were *Timing of Treatment/Inadequate Treatment*, *Care Coordination*, and *Follow-Up Care*.

Timing of Treatment/Inadequate Treatment. The most frequently cited issue among the QIOs in the *Response* domain concerned delays or errors in the administration of antibiotics: "delay in receiving first dose of antibiotics," "delay in antibiotics administration; no surgical antibiotic

prophylaxis; only on acetaminophen," and "inappropriate dosage and coverage of antibiotics" were among the many examples.

Although women's reports of pain were overlooked or discounted in the *Recognition* domain, QIOs about pain in the *Response* domain pointed to inadequate treatment. In many cases, although pain was recognized and treated, there often was no further investigation: "Treated generously with pain medications instead of investigating cause of pain." Diagnostic imaging can facilitate the identification of causes of severe pain, but this technology was underused in pregnant women because of concerns about effects on the developing fetus. In cases with clear indications of infection (e.g., unrelenting headache, significant drop in hemoglobin and hematocrit levels without evidence of bleeding), diagnostic imaging was not done, which contributed to delayed or inadequate treatment.

Care Coordination. Two issues were identified in this theme: appropriate consultations and the role of the nurse. The QIOs pointed to lack of consultations across medical specialties and hospital units for women with severe sepsis: "High-risk patient using ED for primary care" and "Lack of consultations." Specialists who should have been consulted included maternal-fetal medicine physicians, obstetricians (when women were in other locations such as the ED), gastroenterologists, and surgeons. A second issue among QIOs in the *Response* domain related to the role of the nurse and missed opportunities to call the physician, question the plan of care, obtain further assessments before discharge, and ensure that women received home health care follow-up. As frontline caregivers, nurses missed the warning signs (high temperature) and did not communicate the woman's condition to offsite obstetricians: "Nurses may have missed infection triggers and/or not communicated patient's deterioration to MD." QIOs highlighted the importance of empowering nurses to more effectively communicate with physicians and to escalate concerns up the management chain when needed. Appropriate consultation and the role of the nurse are inextricably linked. Lack of recognition among nurses of signs and symptoms led to missed opportunities to perform more thorough assessments, heighten clinical surveillance, and better coordinate management of high-risk cases across relevant medical specialties.

Follow-Up Care. The final theme in the *Response* domain was related to inadequate and untimely follow-up care for women after hospital discharge, particularly among those at high risk for sepsis. The *Follow-Up Care* theme referred to home visiting by trained nurses or office visits in the first 2 weeks postpartum, especially for women with third- and fourth-degree lacerations, operative vaginal births, a newborn with shoulder dystocia, or elevated temperatures close to the time of hospital discharge. Committee members noted, "Discharged with 38.8 °C/102 °F temperature within [previous] 24 hours after operative vaginal delivery, with inadequate evaluation," and "Woman discharged too early with no real follow-up plan."

Exemplar Cases With QIOs

The following two vignettes were created from a compilation of actual cases reviewed. They represent QIOs that were typically seen in cases of maternal death from sepsis. Pseudonyms are used.

Vignette 1. Norah was a gravida 3, para 2 Hispanic woman who spoke only Spanish. Her body mass index was 29 kg/m². She presented to her obstetrician's office reporting leaking vaginal fluid for the last 3 days. Spontaneous rupture of membranes was confirmed, and she was admitted to the labor and delivery unit for induction of labor at 40 5/7 weeks gestation with prolonged premature rupture of membranes. Her prenatal genitoperineal culture result was negative for Group B *Streptococcus* species. On admission she was afebrile. Norah was started on intravenous oxytocin and had a vaginal birth with a second-degree perineal laceration that was repaired under local anesthesia. She experienced a retained placenta that was manually removed under intravenous analgesia. No antibiotics were administered. Norah was discharged to home 28 hours after giving birth. On Postpartum Day 4, Norah went to the ED of the closest hospital, which was not her birth hospital. She reported "not feeling well" and fever for "a couple days." Norah's temperature was 38.3 °C /101 °F, her respiratory rate was 24 breaths/minute, her heart rate was 120 beats/minute, and her white blood cell count was $8.7 \times 10^3/\text{mcl}$. The ED physician phoned the obstetrician on call, who stated that her temperature was likely due to her milk coming in. She was diagnosed with engorgement, dehydration, and exhaustion from recent childbirth and the care of her newborn.

Improving perinatal assessment and early recognition of infectious signs and symptoms are key strategies to prevent women's deaths caused by sepsis.

She was discharged from the ED 2 hours later with a prescription for oral amoxicillin/clavulanate. Norah returned to the ED on Postpartum Day 6 with a temperature of 40.4 °C/104.8 °F, blood pressure of 85/50 mm Hg, respiratory rate of 30 breaths/minute, and oxygen saturation of 85%. She was admitted to the ICU and given fluid resuscitation and broad-spectrum antibiotics, but her condition continued to deteriorate over the next 24 hours, and she died on Postpartum Day 7 of fulminating intrauterine infection and overwhelming sepsis.

Quality improvement opportunities:

- Lack of knowledge of when to seek care (rupture of membranes for 3 days, fever for 2 days, not feeling well for several days)
- Possible language barrier for discharge education
- Lack of continuity of care (not at birth hospital; no prenatal care/birth record)
- Lack of consultation and concerns over location of care (seen by ED physician only)
- Did not recognize abnormal vital signs (heart rate >120 beats/minute, temperature > 38 °C/100.4 °F, systolic blood pressure < 90 mm Hg)
- Inadequate response when discharged from ED with respiratory rate of 24 breaths/minute and fever
- Inadequate response with no prophylactic antibiotics after manual removal of the placenta
- Inadequate recognition and response when discharged early, despite risk factors (prolonged ruptured membranes and retained placenta)
- Lack of detailed instructions on when to return to the hospital

Vignette 2. Cadence was a gravida 1, para 0 White woman at 30 6/7 weeks gestation. She presented to an urgent care center with a complaint of headache for the past 14 days, which she rated as 10 out of 10 on a numeric pain scale. On physical examination, the provider noted that Cadence's pain was worse with flexion of her neck, but she did "not appear to be in distress." Cadence was given acetaminophen and was sent home. No laboratory studies were obtained, and no vital signs were

evident in the medical record. Cadence presented to the ED 6 days later at 31 5/7 weeks gestation by ambulance after a seizure with altered level of consciousness. She was admitted to the ICU, received intravenous hydration, and was started immediately on antibiotics, antifungals, and antivirals. Viral meningitis was diagnosed. She was intubated and placed on a respirator, received an intraventricular shunt, gave birth by cesarean at 34 weeks gestation, and ultimately died 14 days later.

Quality improvement opportunities:

- Lack of recognition and response in the urgent care center: more thorough evaluation of headache was needed
- Lack of evidence of vital signs and laboratory values when in the urgent care center
- Lack of consultation and concerns about location of care without follow-up by an obstetrician

Discussion

Overall, our findings showed several key deficiencies in the care of women who died of sepsis, and QIOs were identified in the *Readiness*, *Recognition*, and *Response* domains of the 4R Framework. The single most common theme in our findings was women's lack of recognition of the signs and symptoms of sepsis or risk for sepsis during the initial birth hospitalization or postpartum period. However, this finding is closely related to maternity care providers' delays in recognizing the symptoms of sepsis, which was a theme in our data and was reported by Bauer et al. (2015) in their analysis of maternal deaths from sepsis in Michigan. Similarly, after the 2014 *Saving Mother's Lives* report, the U.K. National Health System mandated audited training of all clinical staff in the identification and initial management of pregnancy-associated sepsis (Oud, 2016).

In the United States, the National Partnership for Maternal Safety published a list of vital signs and behaviors that should prompt nurses to recognize abnormal findings and communicate those findings to the maternity care provider (Mhyre et al., 2014). The vital sign/behavior list is called the Maternal Early Warning Criteria. It contains many of the same vital sign abnormalities noted in our study, such as tachycardia, tachypnea, hypotension, and decreased oxygen saturation. Mhyre et al. (2014) noted that women who exhibit any of

the criteria should receive bedside evaluation by providers who are able to activate emergency diagnostic and therapeutic interventions.

Effective communication is vital in the provision of safe and effective care to women during pregnancy and the postpartum period (Brennan & Keohane, 2016). In their study of the effect of communication on maternal morbidity and mortality, Brennan and Keohane (2016) noted that communication policies must include escalation components. They also discussed the challenge of some health care team members who struggle to speak up, which can result in delays in treatment and the mobilization of resources. We noted several themes that revolved around physicians who did not seek consultations when needed and nurses who did not communicate their findings to maternity care providers or feel empowered to escalate concerns up the chain of command. Brennan and Keohane (2016) suggested several strategies to improve communication, including the use of structured, standardized communication tools such as purposeful, unambiguous, respectful, and effective (PURE) communication; situation, background, assessment, and recommendation (SBAR); illness, patient, action, situation, and synthesis (I-PASS); and health care team huddles. They also recommended communication improvement programs such as TeamSTEPPS (Agency for Healthcare Research and Quality, n.d.). Mhyre et al. (2014) noted that facilities should have clear communication policies that include how and when to activate the chain of command.

Many of the women who died of sepsis did not seek medical care in a timely manner, which suggests lack of appropriate discharge education. Suplee, Kleppel, and Bingham (2016) investigated this issue and found that the primary method of discharge education was individualized instruction with booklets or folders of information. D'Oria, Myers, and Logsdon (2016) noted that education is an important component of care for women during and after birth and recommended that women and their families be included in discharge planning. The importance of including family in the discharge education process was also stressed in the themes of this study, especially because many of the women who delayed seeking medical care may have been in denial about how sick they were, did not know which symptoms should cause them to seek care, may have been too ill to make appropriate decisions about seeking care, or faced financial or transportation barriers. Having

family members aware of when to seek medical care could improve women's chances of seeking care sooner.

Conclusion

To reverse the effect of sepsis on rising rates of maternal mortality, clinicians need to use strategies and tools to reduce delays in seeking care; better recognize the symptoms of sepsis; and respond with appropriate, timely treatment. Examples include the adoption and use of standardized and comprehensive discharge education for women after childbirth and standardized guidelines for recognition, such as the Maternal Early Warning Criteria. Nurse leaders can play a significant role in the development and implementation of strategies to reduce morbidity and mortality of women caused by sepsis in the perinatal period.

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