

Maternal Early Warning Systems



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KEYWORDS

- Maternal early warning system • Modified early obstetric warning system
- Modified early warning criteria • Maternal morbidity • Maternal mortality

KEY POINTS

- Maternal mortality case reviews find that severe vital sign abnormalities often precede clinical recognition of critical illness.
- Early warning systems have been used in other specialties to identify patients at high risk for clinical decompensation.
- Specific early warning criteria have been developed for obstetric patients.
- Maternal early warning systems are being advocated by obstetric leadership.
- Although early warning systems are a promising strategy for improving maternal outcomes, research evidence is limited.

INTRODUCTION

The burden posed by severe morbidity and mortality during pregnancy and childbirth in the developed world has long been overlooked, and prevention has been neglected despite its vital importance in improving outcomes. As a result, recent data indicate that maternal death and severe morbidity—key indicators of population health—not only remain common¹ but are actually increasing in the United States.^{2,3} Dramatic advances in neonatal and fetal care over the past 3 decades have not been matched by improved maternal care, with the Centers for Disease Control and Prevention estimating that 52,000 women suffer major morbidity annually.² National organizations, including the American Congress of Obstetricians and Gynecologists, American Board of Obstetrics and Gynecology, the Society for Maternal-Fetal Medicine, the Joint Commission, Amnesty International, and the Eunice Shriver Kennedy National Institute of Child Health and Human development have all recently issued recommendations to the obstetric community to increase awareness of maternal mortality and promote improved care of the mother. The failure to prioritize maternal care—a

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question of “Where is the ‘M’ in maternal-fetal medicine?”⁴—has led to educational, clinical, and research initiatives to improving maternal outcomes.⁵ However, efforts to decrease maternal death and severe morbidity have been limited, and the only validated strategy that has emerged to systematically improve maternal outcomes is routine use of postcesarean thromboembolism prophylaxis.^{6,7}

Many cases of major maternal morbidity and mortality may be preventable,^{7–9} and obstetric early warning systems that alert care providers of abnormal physiologic parameters that may precede critical illness have been advocated,⁷ as they may represent a means of improving clinical outcomes. Other specialties have used early warning systems to predict clinical deterioration with varying success.¹⁰ In its 2007 triennial report on maternal death, the United Kingdom’s Confidential Enquiry into Maternal Death recommended adoption of the modified early obstetric warning system (MEOWS)¹¹ which utilizes a combination of physiologic and neurologic parameters to identify obstetric inpatients who require urgent or emergent evaluation by a care provider. The parameters in MEOWS seek to identify patients with hypertensive disorders, hemorrhage, thromboembolism, sepsis, and cardiovascular and cerebrovascular complications, conditions that account for more than 50% of all maternal deaths and disproportionate major morbidity.^{1,7,12} Given the need to implement strategies that will systematically improve maternal outcomes and the emerging interest and research literature on maternal early warning systems, this review covers the following topics:

1. The clinical rationale for early warning systems including the research literature on early alerts in other specialties
2. Clinical parameters and recommended care in maternal early warning systems
3. Research evidence supporting maternal early warning systems
4. Future directions in optimizing and validating maternal early warning systems

EARLY WARNING SYSTEMS IN OTHER SPECIALTIES

Early warning systems have been used in several specialties, primarily with the goal of identifying patients who may become critically ill and improving outcomes with early intervention. These systems are classified as either triggering systems, in which a patient is at risk based on one positive parameter, or scoring systems, in which different parameters contribute to a single numerical value and score cutoff levels predict risk.^{13,14} The Pediatric Early Warning Score created by Duncan and colleagues¹⁵ to predict actual or impending cardiopulmonary arrest in hospitalized children is shown in **Table 1**. In their cohort of more than 32,000 patients, a cutoff score of 5 was 78% sensitive and 95% specific in predicting actual or impending cardiopulmonary arrest with an area under the receiver operating characteristic (AUROC) curve of 0.90, yielding 68 true-positive and 1763 false-positive cases. Findings from their analysis show an important consideration in early warning systems: in a population with low risk for critical illness, even alert systems with test characteristics that perform relatively well may result in large numbers of false-positive cases.

Early warning systems and scores have been studied in several clinical settings including pediatrics,^{14,16} general medical and surgical admission populations,^{17–19} and medical²⁰ and surgical²¹ specialties. The quality of data supporting the use of individual systems is generally poor.²² The number of alert systems has proliferated, and studies generally lack appropriate methodology and adequate statistical powering given the relative infrequency of critical illness that may occur even in a large population. A systematic review of pediatric early warning systems found that the validity, reliability, and utility of pediatric alert criteria were weak.¹³ A systematic review of early warning

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