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The utility of bedside simulation for training in critical care obstetrics

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ABSTRACT

Over the last 2 decades, the maternal mortality ratio in the United States has doubled from 7.4/100,000 live births in 1986 to 14.5/100,000 today. Despite great advances in health care, increasing rates of maternal morbidity and mortality in the United States have prompted calls to action to reverse this disturbing trend. Assisted reproductive technology has allowed women to delay childbearing to more advanced ages, resulting in a greater number of pregnancies complicated by one or more of the diseases associated with aging, such as cardiovascular disease, cancer, type 2 diabetes, and hypertension. The obesity epidemic, increasing rates of chronic diseases affecting pregnancy, steadily rising cesarean delivery rate with resulting complications, and medical advances allowing women with rare, but serious diseases to conceive contribute to rising maternal morbidity and mortality rates. Obstetric critical care simulation training may result in improved multidisciplinary teamwork and patient outcomes; and fewer medical and communication errors.

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Introduction

Over the last 2 decades, the maternal mortality ratio in the United States has doubled from 7.4/100,000 live births in 1986 to 14.5/100,000 today.¹ In certain subgroups, the number is even more alarming, rising as high as 37.7/100,000 in African-American women.¹ Despite great advances in health care, increasing rates of maternal morbidity and mortality in the United States have prompted calls to action to investigate and intervene in an effort to reverse this disturbing trend.²

Many of the potential contributors to the increasing rates of maternal morbidity and mortality are a direct result of our health care advances and modern-day lifestyle. Assisted reproductive technology has allowed women to delay childbearing to more advanced ages,³ resulting in a greater

number of pregnancies complicated by one or more of the diseases associated with aging, such as cardiovascular disease, cancer, type 2 diabetes, and hypertension. The obesity epidemic, increasing rates of chronic diseases affecting pregnancy,⁴ steadily rising cesarean delivery rate with resulting complications such as abnormal placentation,^{5,6} and medical advances allowing women with rare, but serious medical or genetic diseases to conceive³ all contribute to rising maternal morbidity and mortality rates.

With the population of obstetrical patients becoming increasingly skewed toward women with significant comorbidities, the American Board of Obstetrician Gynecologists (ABOG) sponsored a meeting in 2012 with the American Congress of Obstetricians and Gynecologists (ACOG), the Society for Maternal-Fetal Medicine (SMFM), and the Eunice

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Kennedy Shriver National Institute of Child Health and Human Development (NICHD) with three objectives: (1) to enhance education and training in maternal care, (2) to improve the medical management of pregnant women around the country, and (3) to address critical research gaps in maternal medicine.³ In addition to other recommendations for improving medical management of pregnant women and enhancing the education and training of maternal health care providers, this group endorsed medical simulation training as an improvement over more traditional teaching methods.³

Medical simulation training has been an important adjunct to traditional teaching because the opportunities to care for the growing number of medically complex obstetrical patients remain limited, especially when isolated to a single institution. Although the possibility of experiencing an emergency is not limited to one particular group, these complex patients are often the ones who become critically ill during their pregnancy, labor, and delivery or postpartum care. Simulation training offers an opportunity for multidisciplinary team members to improve their skills and to learn how to care for complicated patients with rare conditions in a safe environment. This interactive educational approach offers opportunities to train in communication, technical skills, and application of knowledge in a near-clinical setting.

Simulation training

Background

Almost 2 decades after the landmark Institute of Medicine report, *To Err is Human*, gave rise to current quality and patient safety metrics, medical errors continue to occur in hospitals at alarming rates, with some estimating greater than 250,000 resultant deaths annually.⁷ From this data, improving quality and patient safety may seem to be a daunting task, but significant strides in advancing consumer health care safety have been made. An important contributing factor to health care improvements has been more rigorous medical team training, particularly the proliferation of simulation-based medical education (SBME) curricula.⁸

Technical skills simulation training for obstetrics

Much work has been done on developing models to train perinatologists to perform fetal procedures such as amniocentesis, chorionic villous sampling, and percutaneous umbilical sampling among others.⁹ Although maternal technical skills simulation research is less prevalent, increased simulation opportunities under controlled settings for less commonly performed discreet procedures, such as placement of an intrauterine balloon tamponade or a B-lynch suture as a treatment for postpartum uterine atony, should improve one's skill level with repetition. Stitely et al.¹⁰ in 2011 showed improved self-assessed competency in placement of a Bakri balloon after simulation. For many providers, it is rare to have the opportunity to perform these procedures prior to a clinical emergency; simulation training may fill that void and result in more favorable patient outcomes.

While some technical procedures performed on pregnant patients are unchanged and adaptable from those performed on nonpregnant patients, the anatomic and physiologic changes of pregnancy may result in unique challenges for critical procedures such as intubation and cardiopulmonary resuscitation. In the anesthesia literature, one review found that maternal mortality during cesarean deliveries was 2.3/100,000 patients undergoing general anesthesia, but 1/90 if failed intubation occurred.¹¹ Additionally, the overall number of pregnant patients requiring critical care procedures is fewer than in nonpregnant patients, resulting in less practical clinical experience. For example, while endotracheal intubation requires 30–74 cases to reach a 90% success rate,^{12,13} anesthesiologists perform fewer intubations of obstetrics patients during their training, as general anesthesia is only used in 8% of all cesarean deliveries, most being emergency cases.¹⁴

Medical knowledge simulation training in obstetrics

In addition to technical skill development, simulation training can be used to help solidify medical knowledge and treatment algorithms for disease processes that rapidly become critical if treatment is not begun expeditiously. Pregnant patients with diabetic ketoacidosis (DKA), sepsis or thyroid storm are examples of such morbidities. A study by Yu et al.¹⁵ involving physicians in training suggested that integration of a DKA simulator into medical curricula may improve trainee knowledge and skills, the mean time to insulin initiation, prevalence of life-threatening hypokalemia, adequate fluid resuscitation, and subsequently patient morbidity and length of stay.

Simulation-based team training in obstetrics

In obstetrics, because rare, emergent events with potentially devastating outcomes for mother and infant occur unexpectedly, it is critical for teams to be able to synthesize knowledge and technical skills while working together to manage clinical situations seamlessly and effectively. Team members not only must know the appropriate medical management and technical skills for the particular emergency, but also must understand their respective roles during the event in order to prevent confusion, delayed care, and medical error. In 2004, the Joint Commission acknowledged that most perinatal injuries are related to communication and organizational culture issues, and recommended team training in perinatal areas to teach staff to work together and communicate more effectively.¹⁶

Increasingly available evidence points to the benefits of Simulation Based Team Training (SBTT) for improving both team functionality and patient outcomes in obstetrics.^{17–25} In 2008, Draycott et al.¹⁷ showed a significant decrease in birth injury rates despite similar rates of shoulder dystocia after requiring all staff to attend an annual, one-day course involving emergency drills and fetal heart rate tracing interpretation. In an interrupted time-series study in the UK, Crofts et al.²⁶ demonstrated that the introduction of an obstetric emergency training program for management of shoulder dystocia resulted in improvements in both

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