EVALUATING THE EFFECT OF AN ONLINE, ASSESSMENT-DRIVEN LEARNING PLATFORM FOR OBSTETRIC PROVIDERS AND NURSES

By

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Date Project Proposal Accepted

The DNP Project committee for Julya Miner certifies that this is the approved version of the following DNP Project:

Evaluating the Effect of an Online, Assessment-driven Learning Platform for Obstetric Providers and Nurses: Can We Improve Perinatal Outcomes?

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Abstract

Maternal mortality rate/ratio (MMR) is a significant indicator of the overall quality of health care. While MMR is declining globally, the United States is one of only eight countries where MMR continues to rise. Sadly, many of the issues contributing to MMR, such as delay in diagnosis or treatment, and failure to recognize patients at risk, are preventable. Deficits in staff knowledge or training are common causative factors in preventable maternal deaths. Simulation, e-learning, and instructor-led courses have been implemented globally in an effort to address preventable factors.

The Model for Improvement dictates the need for outcome evaluation to determine if a change is an improvement. The purpose of this doctoral project was to evaluate perinatal outcomes following the inclusion of an assessment-driven, individualized e-learning platform focused on obstetric emergencies within a blended learning environment. The Kirkpatrick Model for training evaluation provided a structure for this performance improvement project. Sources for perinatal patient outcome data were identified. Pre- and post-implementation data were charted.

Improvements in perinatal outcomes with reduction in maternal morbidity were noted following implementation of the e-learning platform for obstetric emergencies. A slight decrease in overall obstetrical hemorrhage rates was noted (average 54.7/1,000 deliveries down from 56.4/1,000 deliveries at baseline). A slight decrease in massive transfusion rates ($\geq$4 units pRBC) was realized (average 2.2/1,000 deliveries down from 2.4/1,000 deliveries at baseline). Three consecutive months at the end of the performance period noted 0 cases of massive transfusion indicating improved management of obstetrical hemorrhage. The most significant improvement was with a downward shift in maternal intensive care unit (ICU) admission

(average 1.5/1,000 deliveries down from 2.9/1,000 deliveries). Zero ICU admits were noted 6 of the last 7 months of the performance period.

Tracking clinical outcomes validated the effectiveness of the e-learning program within a blended learning environment. Data-driven education reduced waste by right-sizing the training for providers and nurses. The intentional focus on closing gaps in knowledge and training in obstetric emergencies for nurses and providers may help reduce maternal morbidity and mortality moving forward.

Keywords: e-learning, Kirkpatrick Model, maternal morbidity, maternal mortality, Model for Improvement, obstetric, perinatal outcomes, obstetric hemorrhage

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Dedication

The author would like to dedicate this work to her husband Keith Miner and to her boys Kyle Miner, Joshua Miner, and Samuel Miner. You are my inspiration. May we continue to inspire and empower each other to do great things. This work is further dedicated to the women and their families who have experienced significant pregnancy complications. May we continue to learn from these experiences and make the necessary changes to truly improve perinatal outcomes.

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The World Health Organization (WHO) has identified maternal mortality as a global public health concern. Maternal mortality rate or ratio (MMR) is a significant indicator of the overall quality of health care (MacDorman, Declercq, Cabral, & Morton, 2016). While MMR is declining globally, the United States is one of only eight countries where MMR continues to rise (WHO, 2015). The American College of Obstetrics and Gynecology ([ACOG], 2015) declared, "This is unacceptable for women, their children, their families, and society" (p. 1). Many of the issues contributing to MMR are preventable (ACOG, 2016).

The Institute of Medicine ([IOM], 1999) issued a call to action to make healthcare safer by reducing preventable harm. Nursing leaders are well-positioned to drive improvement efforts (IOM, 2010). The purpose of this paper is to present a doctoral project which evaluated the impact of interventions within one organization on maternal morbidity and mortality. The significance of the problem will be sketched, the organization will be introduced, and key concepts will be defined. A comprehensive review of the literature, as it applies to the project, will be presented. The project design and methodology will be reviewed. Results of the data collection will be presented along with a discussion of the implications for clinical practice.

Problem and Significance

Globally, MMR is estimated to be 216 maternal deaths per 100,000 live births (WHO, 2015). In spite of ongoing efforts to address this problem, U.S. trends show pregnancy-related mortality is increasing. Between 2000 and 2015, WHO reported MMR rose from 12 to 14 deaths per 100,000 births in the United States. During a similar timeframe, the Centers for Disease Control and Prevention (CDC) (2017) reported as many as 17.8 maternal deaths per 100,000 births. "More than 700 American women die annually as a result of pregnancy or delivery

complications" (HealthStream, 2018). That equates to nearly 2 maternal deaths per day. Within the state for this project, MMR shows similar trends (S. Deakins, personal communication, February 2, 2018).

The top reasons for maternal death include cardiovascular disease, other medical disease, infection/sepsis and obstetrical (OB) hemorrhage (CDC, 2017). Grobman et al. (2014) concluded that 50% of severe maternal morbidity was associated with OB hemorrhage. Kramer et al. (2013) identified a doubling of the incidence of OB hemorrhage over a ten-year period which was not explained by changes in risk factors within the population. Additionally, failure to recognize abnormal fetal heart rate patterns and intervene immediately leads to adverse neonatal and maternal outcomes (Fahey, 2014).

During a state-level maternal mortality review in Illinois (Geller, Koch, Martin, Rosenberg, & Bigger, 2014; Kilpatrick, Prentice, Jones, & Geller, 2012), researchers discovered nearly one third of maternal deaths were potentially preventable. Delay in diagnosis or treatment, and failure to recognize patients at risk were identified as the most common preventable issues. Deficits in staff knowledge or training were called out as causative factors in preventable maternal deaths. Al-Kadri et al. (2014) identified that OB providers and nurses significantly underestimate blood loss which contributes to delayed recognition of and response to OB hemorrhage.

Improvement efforts focused on strengthening provider and clinician response to and management of OB emergencies can reduce maternal morbidity and mortality. Educational interventions are common strategies to address gaps yet not all training is clinically effective (Draycott et al., 2015). Rigorous clinical demands present a significant barrier for OB providers and nurses to participate in continuing education (Pilcher, 2013). Without demonstration of

clinical effectiveness, required training may be a waste of precious resources. Studies are necessary to determine if these interventions can be linked to improvements in perinatal outcomes (Sinclair, Kable, Levett-Jones, & Booth, 2016).

The Organization

The setting for this project is an nine-hospital non-profit healthcare system in the Northwest region of the US. It realizes approximately 7,500 births annually. Over the past three years, the organization has noted a rise in obstetrical emergencies and unexpected perinatal outcomes. Review of these events identified opportunities for additional staff training in management of OB hemorrhage, interpretation of fetal heart rate monitoring, and supervision of other emergency situations.

In alignment with its mission, the organization joined the national perinatal safety initiative called Mothers and Babies First (MBF). MBF is seeking to determine if implementation of a blended learning model augmented by clinical improvement action plans using the Institute for Healthcare Improvement's (IHI) Model for Improvement will impact maternal morbidity and MMR across the country (Advanced Practice Systems [APS], 2017). The blended learning model includes implementation of the online assessment-driven learning platform called GNOSIS for OB together with various forms of instructor-led courses, simulation, and team training (L. Sparkman, personal communication, December 4, 2017).

GNOSIS for OB includes assessment-driven modules focused on four high-risk OB areas including OB hemorrhage, shoulder dystocia, hypertensive disorders of pregnancy, and fetal assessment and monitoring (APS, 2017). GNOSIS for OB measures knowledge and judgement in these key areas through validated assessment tools. Personalized learning paths are prioritized for each learner based on assessment data. Analytics are provided to identify improvement

areas. This level of robust, data-driven continuing OB education had not been available at this organization before GNOSIS. Instructor-led courses for fetal assessment and monitoring, TeamSTEPPS team training, and simulation had been in place for many years. Yet, opportunities to evaluate the effects of the training had been limited.

Doctoral Project

The organization began implementation of GNOSIS for OB in February 2017. With OB hemorrhage as a leading cause of maternal death, this training area was given first priority. Ninety-three percent of clinicians had completed the OB hemorrhage training module by September 2017 when the next module was launched focused on fetal assessment and monitoring. The purpose of this doctoral project was to evaluate the effect of the implementation of GNOSIS for OB on perinatal outcomes within the organization. The question driving this project was as follows: "Within this organization's maternal population, how does implementation of GNOSIS for OB, within a blended learning environment, affect inpatient perinatal outcomes over the first six to twelve months?"

Key Concepts/Variables

Maternal patients admitted during the study period were the population of focus. Maternal patients were defined as pregnant women or women who had experienced a delivery during the current admission. Perinatal outcomes were monitored during this time with a focus on three primary outcomes; obstetrical hemorrhage, massive transfusion, and maternal intensive care unit admission.

The Joint Commission (2016) defined severe maternal morbidity as "a patient safety event that occurs intrapartum through the immediate postpartum period (24 hours), that requires the transfusion of 4 or more units of packed red blood cells (pRBCs) and/or admission to the

intensive care unit (ICU)" (p. SE-3). Maternal mortality is defined as the death of a woman who is pregnant or who is within 42 days of pregnancy termination (WHO, 2015).

Obstetrical hemorrhage was defined as blood loss > 500 milliliters (mL) with vaginal delivery or > 1000 mL with cesarean delivery (Simpson & Creehan, 2014). Massive transfusion for the purposes of this project was defined as transfusion of 4 or more units of packed red blood cells (pRBC). To support conclusions and/or recommendations from this project, clear metric definitions were essential.

The intervention to be studied included e-learning within a blended learning environment. E-learning contains electronic sources for course material (Pilcher, 2013). E-learning embraces online, internet-based education and is often self-directed by the learner. In contrast, traditional learning involves instructor-led, face-to-face synchronous classroom instruction. The blended learning environment blends both e-learning and traditional instructor-led formats within the learning experience (APS, 2017).

Literature Review

To support the doctoral project, a comprehensive literature review was undertaken using the Matrix Method (Garrard, 2017). The focus of the review was to identify previous studies and scholarly work exploring the effectiveness of e-learning and other training methods for health care providers and clinicians. PubMed, ProQuest, Cumulative Index of Nursing and Allied Health Literature (CINAHL), and Educational Resources Information Center (ERIC) databases were searched. Key search terms included "GNOSIS," "perinatal," "maternal," "intrapartum," "simulation," "computer," "online," "computerized," "digital," "electronic training," "continuing education," "continuing educational units," "continuing medical education," "CME," "simulation," "online," "computerized," "obstetrical," "hemorrhage," "training," and

"professional development." Primary research studies and systematic reviews were mined to find additional resources. Scholarly articles were identified with preference for those published in the English language within the last five years. Articles specific to OB emergency training were limited requiring exploration of studies from other healthcare areas. A total of 32 articles were included in this review.

Findings were organized based on the four levels within the Kirkpatrick Model (2009-2017); learner reaction, degree of learning, behavior change, and targeted outcomes/results. These categories represent a method for evaluating effectiveness of training. To be effective in reducing maternal morbidity and MMR, the model suggests training must be relevant to the participants' work, transfer knowledge, affect behaviors, and improve clinical outcomes.

Learner Reaction

Level 1 evaluation within the Kirkpatrick Model (2009-2017) seeks to identify the learner's reaction to the training: Was it engaging and relevant to their jobs? Did it meet or exceed their expectations? Multiple studies and reviews (Alfieri et al., 2012; Davies, Hauck, Bayes, Barrett, & Jones, 2013; George et al., 2012; Pilcher, 2013; Sinclair, Kable, Levett-Jones, & Booth, 2016; Tomlinson et al., 2013) reported positive learner reactions to the e-learning format over traditional face-to-face learning modalities. Benefits included training that was learner-centered, interactive, accessible 24/7, self-paced, convenient, and flexible.

Negative reactions to e-learning were reported by participants who experienced issues and/or unfamiliarity with technology (Davies et al., 2013). Some studies (Bandla et al., 2012; Pilcher, 2013) reported continued preference for lectures or face-to-face learning platforms over e-learning. Researchers acknowledge that this preference may be due to familiarity rather than representing a true preference (Pilcher, 2013). Tomlinson et al. (2013) found that even those

who verbalized a preference for in-person training acknowledged they would participate in and recommend e-learning to others.

A newer trend in instructor-led training is simulation. Experiential learning is enhanced through simulated scenarios. Many studies (Egenerg et al., 2017; Kominiarek et. Al, 2017; Monrod, Voekt, Gisin, Gisin, & Goesli, 2014; Nelissen et al., 2017; Shoushtarian, Barnett, McMahon, & Ferris, 2014; Spitzer et al., 2014; Van de Ven et al., 2017) have found positive learner feedback from simulation training focused on OB emergencies. Researchers (Egenerg et al., 2017; Nelissen et al., 2017; Spitzer et al., 2014) have found simulation to be especially impactful for clinicians within low resource settings experiencing high rates of maternal morbidity and mortality.

Degree of Learning

The degree of learning or improvement in knowledge, often tested through pre/post-test designs, fulfills Kirkpatrick's (2009-2017) level two evaluation. E-learning platforms have repeatedly resulted in improved understanding of the concepts taught (Alfieri et al., 2012; Bandla et al., 2012; Chao et al., 2016; Davies et al., 2013; Durmaz, Dicle, Cakan, & Cakir, 2012; Hards, Davies, Salman, Erik-Soussi, & Balki, 2012; Subramanian, Timberlake, Mittakanti, Lara, & Brandt, 2012; Tomlinson et al., 2013). Occasionally, studies have found no difference between e-learning and traditional teaching formats (Bandla et al., 2012; Durmaz, Dicle, Cakan, & Cakir, 2012; Hards, Davies, Salman, Erik-Soussi, & Balki, 2012; Tomlinson et al., 2013). Subramanian et al. (2012) reported significantly higher learning retention after e-learning when compared to traditional lecture formats.

The evidence from these studies supports application to OB emergency training. Initial knowledge transfer is effective and potentially more effective through e-learning formats. The

assessment-driven learning platform of GNOSIS for OB imbeds a process for measuring learning improvement through re-assessment (APS, 2017).

Behavior Change

The real value of a training program comes when learning is reflected within practice by way of behavior change. This marks level 3 evaluation in the Kirkpatrick Model (2009-2017). Chao et al. (2016) discovered a significant improvement in desired behaviors within practice between weeks 4 and 16 following a blended learning intervention for nurses providing long-term care. This blended learning intervention included both classroom teaching and self-directed e-learning activities. Pape-Koehler et al. (2013) found that a multimedia-based training program for surgical providers improved surgical performance significantly when compared with practical training alone, combo training (multimedia-based plus practical training), or no training at all. Technical skills ranked highest among the group taught through multimedia alone.

Durmaz et al. (2012) compared nursing student skill improvement following a screen-based computer simulation versus training provided in a skills laboratory. While improvement was noted following training, researchers found no significant difference in knowledge, skills, or clinical decision making between groups. The authors concluded that education provided through e-learning was equivalent to that provided through the skills laboratory. Hards et al. (2012) also found that while learning improved with any training, no significant difference was noted in technical or nontechnical skills when comparing didactic training with e-learning for anesthesia residents on management of maternal cardiac arrest.

Einerson, Miller, and Grobman (2015) evaluated behavior changes within clinical practice following introduction of an OB hemorrhage safety program. Nursing staff, residents, fellows, midwives, and physician providers for OB and anesthesia received training on

estimating blood loss, use of OB hemorrhage management checklists and active management of third stage of labor. Researchers discovered an increased use of uterotonics, cryoprecipitate, intrauterine balloon tamponade, B-Lynch suture placement, and uterine artery embolization following the training. Nelissen et al. (2017) similarly documented improvements in use of oxytocin, removal of placenta by controlled cord traction, and uterine massage after birth following a half-day simulation-based training in Tanzania. Al-Kadri et al. (2014) identified an improvement in accuracy of blood loss estimation following in-person training using simulated blood loss stations in Saudi Arabia. Spitzer et al. (2014) found that the number of patients receiving oxytocin increased following a 5-day emergency OB training in Kenya. Monrod et al. (2014) found participants in Switzerland rated their clinical skills higher at three months than immediately following simulation training on six OB emergency situations (shoulder dystocia, OB hemorrhage, pre-eclampsia, basic life support, operative vaginal delivery, and neonatal resuscitation). These studies support improvements in professional OB competency through simulation-based training.

Targeted Outcomes/Results

When determining if a change has led to an improvement, the Model for Improvement (Institute for Healthcare Improvement [IHI], 2017) advocates for measurement of outcomes. Similarly, the crowning step in the evaluation process using the Kirkpatrick Model (2009-2017) is evaluating targeted outcomes. Unfortunately, few studies were identified which measured changes in clinical outcomes following e-learning. In fact, authors of a recently published systematic review (Sinclair et al., 2016) claim to have been unable to find any published works which reported effectiveness of an e-learning program on patient outcomes. Alfieri et al. (2012)

explained that limited resources and time were the rationale for not pursuing the level 4 evaluation in their study.

Three studies (Chao et al., 2012; Santos et al., 2015; Wagner et al., 2012) were identified in which clinical outcomes were monitored following e-learning interventions. A performance improvement study by Santos et al., (2015) identified a significant decrease in high-risk malpractice events following implementation of a multilevel integrated risk reduction model which included e-learning modules for shoulder dystocia and advanced fetal assessment and monitoring. Implementation of standardized protocols, event reporting and investigation were also part of the initiative. A 50% reduction in shoulder dystocia and fetal distress cases was realized. Wagner et al. (2012) evaluated a similar multistep, multicomponent perinatal safety initiative which included e-learning with competency exam for electronic fetal monitoring. Significant improvements were noted in both primary and secondary outcome measures. A significant decrease was seen in rates of return to the operating room, and birth trauma. Improvements were noted in staff perception of patient safety and patient perception of whether staff worked together. Chao et al. (2016) also documented improved patient outcomes following implementation of a blended learning model (e-learning with some instructor-led training) for long-term care nurses. By week 16, a significant decrease in memory and behavior-related problems, as well as depressive symptoms were seen in patients within the long-term care facilities.

Bingham (2012) postulated that a delay in data availability to front-line clinicians contributes to a delay in practice change to impact MMR. Callaghan, Grobman, Kilpatrick, Main, and D'Alton (2014) proposed a simple, validated scoring system to identify cases of maternal morbidity for review. The two-factor scoring system included intensive care unit

admission and/or transfusion of four or more units of blood products. Kilpatrick et al. (2014) advocated the use of this criteria to guide a standardized severe maternal morbidity interdisciplinary review process due to its simplicity and sensitivity. Bingham and Jones (2012) declared that "accurate and timely data are needed to guide leaders' quality improvement initiatives" (p. 534).

Recent studies (Egenberg et al., 2017; Einersonet al., 2015; Kominiarek et al., 2017; Shields, Wiesner, Fulton, & Pelletreau, 2015; Shoushtarian et al., 2013; Spitzer et al., 2014; Nelissen et al., 2017; Skupski et al., 2017; van de Ven et al, 2017) have identified improved perinatal outcomes through programs which integrated instruction with simulation and protocol development. Significant increases in teamwork and safety scores were realized following a blended learning experience in Australia which included short lectures and scenario-based simulation training (Shoushtarian et al., 2014). Neonatal outcomes were also impacted as evidenced by improvements in Apgar 1, cord lactates, and average length of inpatient stay for baby. A study at Northwestern Memorial Hospital in Illinois (Einerson et al., 2015) found that while there was no significant difference in frequency of intensive care admission or postpartum hysterectomy, the number of days between maternal intensive care admissions was significantly increased following implementation of an OB hemorrhage safety program.

Draycott et al. (2015) identified that annual training was more effective in sustainability of outcomes. Van de ven et al. (2017) later identified that gains initially seen immediately following simulation training in OB emergencies, waned after just three months. Researchers concluded that repetitive training was necessary to sustain gains beyond the first quarter. Skupski et al. (2017) validated that sustainability of intended outcomes required frequent repetition of the training content. Daily pearls and monthly didactic training focused on OB

hemorrhage management along with the organization of a rapid response team and a massive transfusion protocol were part of their program, which realized a progressive decrease in maternal morbidity despite increasing rates of OB hemorrhage.

Low-resource areas have seen significant impact to mothers and babies through simulation-based training for OB emergencies (Egenberg et al., 2017; Nelissen et al., 2017; Spitzer et al., 2014). Moi Teaching and Referral Hospital in Kenya found that OB hemorrhage cases decreased along with the number of neonates with a 5-minute Apgar score less than 5 following a five-day course for nurses and providers (Spitzer et al., 2014). Areas of Tanzania experienced a 38% reduction in the incidence of OB hemorrhage following a half-day simulation-based training (Nelissen et al., 2017). A 47% drop in blood transfusion rates was realized through an on-site interprofessional, scenario-based OB hemorrhage training also implemented in Tanzania (Egenberg et al., 2017).

Bandla et al. (2012) included an evaluation of cost and potential cost savings within the study of an online sleep medicine curriculum for medical students. First-year costs for the e-learning format were equivalent to the instructor-led format due to the resources needed to develop the online curriculum. These initial development costs would not be repeated in subsequent years thus supporting an anticipated savings. The authors concluded that the "cost effectiveness of online learning is an economically and educationally viable instruction platform" (p. 439). In a time when healthcare is challenged to be more cost effective and efficient (IOM, 1999), e-learning seems to be a reasonable platform to consider.

Summary

The e-learning platform of GNOSIS for OB was identified only once in the literature (Hartwig & Schwartz, 2014). The report merely introduced the abstract for a poster presentation

to be included in the Association of Women's Health Obstetrics and Gynecology (AWHONN) National Convention 2014. GNOSIS was implemented as part of a perinatal safety improvement initiative along with several other interventions. No results were shared. Clearly, additional studies are needed to link this e-learning platform with clinical outcomes and other desired results.

In the study of an online training program focused on dental health screenings, George et al. (2012) found that certified nurse-midwives (CNMs) requested competency testing be included as part of the program. The CNMs explained that competency testing contributes to confidence to deliver the new service. Assessment of provider competence with electronic fetal monitoring has been implemented in some facilities across the country in an effort to improve perinatal outcomes (Nageotte, Tomlinson, & O'Keefe, 2016). Competency testing alone is insufficient if gaps in understanding are not mitigated. "Those who do not pass could benefit from educational efforts focused specifically on the areas in which they fell short" (Nageotte et al., 2016, p. 23).

Fahey (2014) recognized "there are promising innovations in individual provider education programs that focus on improving clinical judgement . . . including approaches that provide adaptive, individualized content. Evidence documenting their effectiveness in improving clinical outcomes, however, is currently unavailable" (p. 621). At the time of implementation, the GNOSIS for OB platform provided proficiency assessments in both knowledge and judgement for four high-risk OB areas: shoulder dystocia, hypertensive disorders of pregnancy, obstetrical hemorrhage, and fetal assessment and monitoring. Following proficiency testing, an individualized learning path is mapped out to meet the identified learning needs. This individualized learning path is set up in modular learning sessions which can be accessed from any Internet-enabled device and completed in just a few minutes (APS, 2017).

Careful data collection and reporting will reveal if this innovative learning platform called GNOSIS for OB can be associated with a reduction in maternal morbidity and mortality.

Educational curriculum designed to be learner-centered, accessible, self-paced, and meaningful has been found to be more appealing (Pilcher, 2013). Education delivered electronically, or e-learning, has some distinct advantages over other learning mediums in meeting these learning preferences. Based on the Kirkpatrick Model of evaluation for training, e-learning formats are supported by the literature as effective, cost-efficient ways to deliver training to health care providers and clinicians. E-learning platforms are received favorably by participants, and both immediate and long-term improvements in knowledge, skills, and attitudes have been documented. Further data is needed to link e-learning with improvements in clinical outcomes.

In a systematic review of OB emergency and neonatal care training using a refined Kirkpatrick Model, Bergh et al. (2015) concluded that single educational interventions were not as effective. To be most effective, training must be integrated with interventional programs, which include emergency drills. Application of the learning within the practice area is further supported as structures and processes are implemented which aid in reinforcing the desired practice. Clinical protocols, cognitive aids, and simulation make a stronger impact on OB clinical outcomes than knowledge transfer alone (Shields, Wiesner, Fulton, & Pelletreau, 2015; The Veteran's Administration National Center for Patient Safety, 2015).

Overall, the literature supports the use of a blend of e-learning, instructor-led training, and simulation to effectively educate clinical teams. Activation of the learning within practice is supported through standardized processes outlined in clinical protocols, checklists, and other

cognitive aids. Evaluation of clinical outcomes is essential to know if the training results in the desired improvement.

Project Details

Design

The Model for Improvement (MFI) (IHI, 2017) provides a framework to support rapid cycle testing of changes through outcome evaluation. Within the MFI, plan-do-study-act (PDSA) cycles drive identification of concerns, development of plans to address those concerns, implementation of interventions, and a study of results followed by incremental adjustments to the interventions until desired outcomes are achieved. A key question within the MFI is "how will you know if a change is an improvement?" Outcome measures must be identified that will document meaningful improvement.

Within the MFI framework, GNOSIS for OB was implemented at the participating organization. Transformational and transactional leadership styles were utilized to gain buy-in and support accountability for the implementation. Clarke (2013) identified this juxtaposition of transformational and transactional leadership as safety leadership. Rising numbers of OB emergencies and adverse perinatal outcomes moved the organization to intervene by changing the way education was provided to clinical team members. While the literature supports an expected improvement in clinical outcomes through this e-learning intervention, data was required to validate this assumption.

Adult Learning Theory further supports the assumption that this e-learning intervention will be successful (Pappas, 2013). Knowles Adult Learning Theory is built on several key assumptions. First, adult learners are mature enough to be self-directed. Second, the wealth of their life experience is a resource for learning. Third, social roles guide readiness to learn with a

desire for immediate application of new knowledge. Fourth, the orientation to learning is unique to adult learners. Rather than desiring subject-centered learning, adult learners are oriented toward problem centeredness. Finally, adult learners have an internal motivation for learning.

Knowles, Holton, and Swanson (1973) further outline 4 principles that are applied to adult learning: 1) adults need to be involved in their instruction, 2) experience is key to learning, 3) immediate relevance and personal impact sparks interest, and 4) problem-centered instruction is more meaningful than merely presenting content. The GNOSIS for OB e-learning platform honors the experience that each adult learner brings by individualizing the learning path based on assessment scores (APS, 2017). Participants are guided to problem-centered instruction in the areas where they personally demonstrate a greater need for review. There is immediate relevance within their clinical practice for the things they are studying.

The Kirkpatrick Model (2009-2017) for evaluation of training programs was selected to guide evaluation of GNOSIS for OB at this organization. This model outlines four levels of evaluation: level 1) reaction; level 2) learning; level 3) behavior, and level 4) results. Many studies (Alfieri et al., 2012; Davies et al., 2013; Durmaz et al., 2012, George et al., 2012; Hards et al., 2012, Pilcher, 2013; Sinclair, et al., 2016; Subramanian et al., 2013, Tomlinson et al., 2013) of e-learning have explored learner reaction, levels of learning, and behavior change following training program implementation. The intent of this project was to avoid repeating analysis which was already well documented. The focus of this program evaluation was at level 4, measuring results. Identification of the degree to which targeted clinical outcomes were realized as a result of the training was essential to define the value of the program.

Methodology

A quality improvement designation was sought from both the healthcare organization and the University of Kansas. After careful review, the Institutional Review Board for the organization where the work took place deemed this project performance improvement. The Human Research Protection Program of the University of Kansas deemed this project quality improvement/healthcare oversight. (See Appendix 1 Human Subjects Forms).

While the primary objective of the educational intervention was to reduce maternal mortality, events resulting in maternal death are thankfully rare. Significant complications of pregnancy occur more frequently and can be a reliable source for identification of improvement opportunities (Callaghan et al., 2014). A two-factor scoring system approach to evaluation of severe maternal morbidity was proposed by Callaghan et al. (2014) and validated by Kilpatrick et al., (2014). Intensive care unit (ICU) admission and/or transfusion of four or more units of blood products were the measures of focus. Monitoring severe maternal morbidity can guide rapid cycle change initiatives to support quality improvement.

A retrospective chart review methodology was arranged for this quality improvement project. Working closely with a PhD-prepared Business Systems Analyst, data was extracted from the electronic health record (EHR). Sources for perinatal outcome data were identified. Data was extracted systematically from electronic primary and secondary sources by the Business System Analyst and provided to the author in a de-identified manner. De-identification of the data was realized through the Safe Harbor method. Through the Safe Harbor method the following identifiers were removed: names, geographic subdivisions smaller than a state, all elements of dates (except year) directly related to an individual, telephone numbers, fax numbers, email addresses, social security numbers, medical record numbers, health plan

beneficiary numbers, account numbers, certificate/license numbers, vehicle identifiers, device identifiers, web universal resource locators (URLs), internet protocol (IP) addresses, biometric identifiers, full-face photographs, or any other unique identifying number, characteristic, or code (US Department of Health and Human Services, n.d.).

Three outcome measures were selected as the focus for this project; OB hemorrhage, massive transfusion, and maternal ICU admission. OB hemorrhage was defined as an estimated blood loss > 500 mL following vaginal delivery or > 1000 mL following a cesarean delivery. Massive transfusion was defined as OB hemorrhage cases requiring transfusion of 4 or more units of packed red blood cells (pRBC). Patients admitted for delivery of a baby and who received care in the intensive care unit anytime during their hospitalization defined a maternal ICU admission. Rates were calculated per 1,000 deliveries.

Data was plotted to obtain baseline and performance period comparisons within the organization. Baseline data included all maternal patients who delivered babies within the organization between October 1, 2016 and March 31, 2017. The performance period included the first 12 months following initiation of the GNOSIS for OB e-learning platform. Performance period data included evaluation of all maternal patients who delivered within the organization April 1, 2017 – March 31, 2018. Patients were identified through the EHR based on recorded delivery date.

Rates for the primary outcome measures were calculated per 1,000 deliveries. Descriptive statistics for each outcome measure were obtained. Control charts and median run charts were plotted. Lloyd (2004) suggests the use of control charts to evaluate process variation. Data was plotted to determine the amount of variation around the mean or average. Upper and lower control limits were calculated. In contrast, run charts plot the data around the

median rather than the mean. Run charts are useful to determine if trends are present within the data.

Four tests can be applied to a run chart (Lloyd, 2004). Test #1 "too few or too many runs" guides identification of special cause versus common cause variation. Special cause variation is identified if there are too few or too many runs based on the number of useful observations in the data. Data points that fall on the median line are not considered useful. One or more consecutive data points on the same side of the median line is considered a run. Special cause is identified if the number of runs falls below the lower limit or above the upper limit identified on a table based on the number of useful data points.

Run chart test #2 "a shift in the process" helps determine if a process has truly moved in the direction of improvement. One or two data points that are "better" are not sufficient to define a shift. If there are fewer than 20 data points in the data set, a run of 7 or more data points are required to validate a shift in the process. If there are more than 20 data points in the data set, 8 or more data points are required in the run to determine a shift. For this project, 18 data points were included in the data set.

Test #3 seeks to identify "a trend." "A trend is an unusually long series of consecutive data points constantly going up or constantly going down (Lloyd, 2004, p. 190). For the 18 data point data set, a trend would be identified by six or more data points constantly increasing or decreasing. For Test #3, data points on the median are counted but points which repeat the previous value are ignored.

Stratification is Test #4. "Stratification is defined as a cyclical pattern of up and down data points that forms a sawtooth or zigzag pattern…[F]ourteen or more consecutive data points fluctuating up and down define stratification" (Lloyd, 2004, p. 191). The presence of

stratification may indicate a problem with data collection. Stratification represents the presence of multiple processes which may be confounding the data. For example, one shift or team may be performing at a high lever while another shift of team performs more consistently at a lower level. Data may need to be split up and evaluated per shift in order to draw meaningful conclusions.

Performance trends and opportunities were identified through internal and external benchmarking. Visual data displays were created in such a way that frontline team members could interpret and act upon the data. Ongoing improvement work, within the MFI, was supported.

Results

OB hemorrhage, also known as Postpartum hemorrhage (PPH), rates were evaluated first. The baseline period showed an average of 56.4 cases per 1,000 deliveries with a median PPH rate of 55.7. Slight decreases in PPH rates were noted over the performance period. The average and median PPH rates for the performance period were both 54.7. When plotted in a control chart, the upper control limit was noted to be lower during the performance period (see *Figure 1*). Narrowing control limits demonstrates a less variable and more reliable process (Lloyd, 2004).

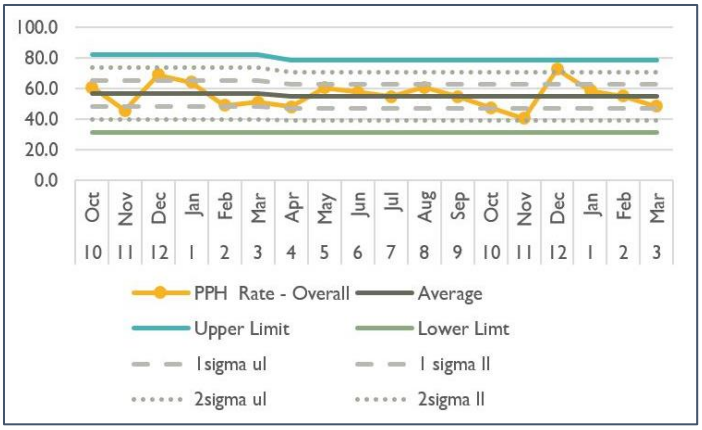

Figure 1 Overall Postpartum Hemorrhage Rate Control Chart.
The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

Plotting the data on a median run chart allowed application of run chart rules to determine if there were trends in the data (see *Figure 2*). For this data set, fifteen useful observations were identified with 8 runs. Overall, no significant trends or shifts were noted. No special cause variation was identified. Stratification was not present.

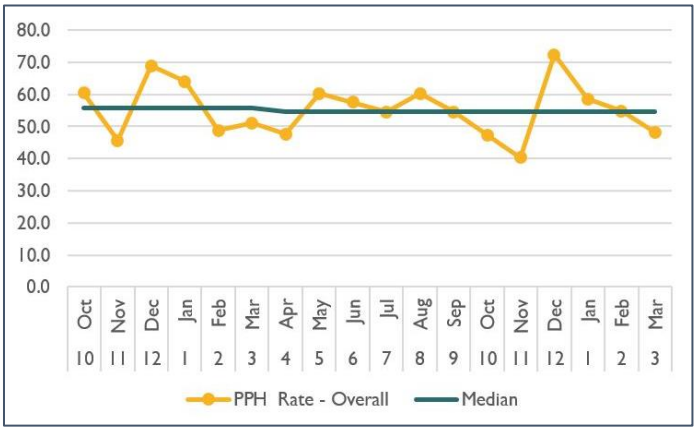

Figure 2 Overall Postpartum Hemorrhage Rate Median Run Chart.
The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

When looking at data for PPH with vaginal delivery separately from cesarean delivery, still no significant trends or shifts were noted. Tighter control limits were identified for PPH rates for vaginal delivery (see *Figure 3*) while wider controls were noted with cesarean delivery

(see *Figure 4*). Likely the wider controls for PPH with cesarean delivery are due to a lower *n* overall. The tighter control limits seen with PPH with vaginal delivery supports a conclusion that processes for identifying and responding to PPH became more standardized, less variable, and more reliable following the intervention.

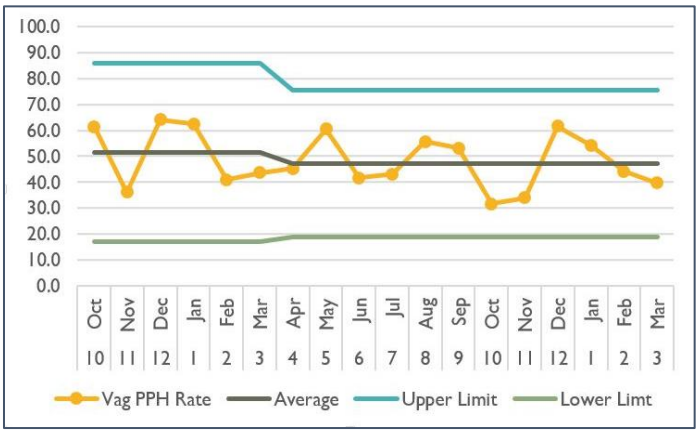

Figure 3 Vaginal Delivery Postpartum Hemorrhage Rate Control Chart.
The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

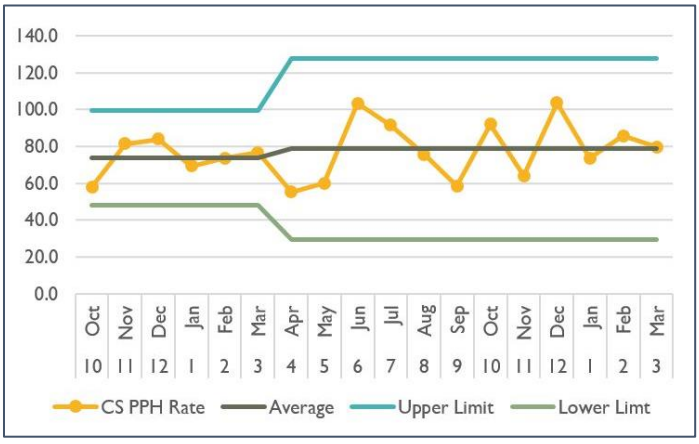

Figure 4 Cesarean Delivery Postpartum Hemorrhage Rate Control Chart.
The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

Process improvements were also validated by a slight decrease in rates of massive transfusion ($\geq$ 4 units pRBC) (see *Figure 5*). Performance period data demonstrated an average rate of 2.2 per 1,000 deliveries and median rate of 1.5 compared with 2.4 and 2.3 respectively for

the baseline period. Three consecutive months of 0 were noted at the end of the performance period defined for this project (see *Figure 6*). While no significant trends or shifts could be verified with this 18 point data set, outcome measures plotted through May 2018 did validate a downward shift in massive transfusion. A rate of zero massive transfusions was maintained through May 2018.

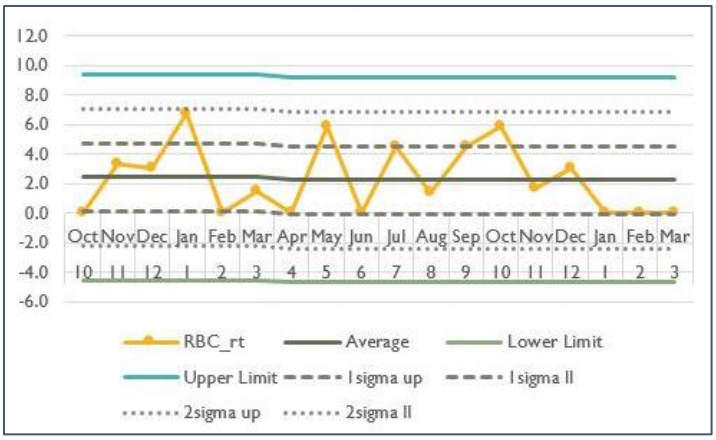

Figure 5 Massive Transfusion Control Chart.
Massive Transfusion was defined as transfusion of ≥ 4 units of pRBC. The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

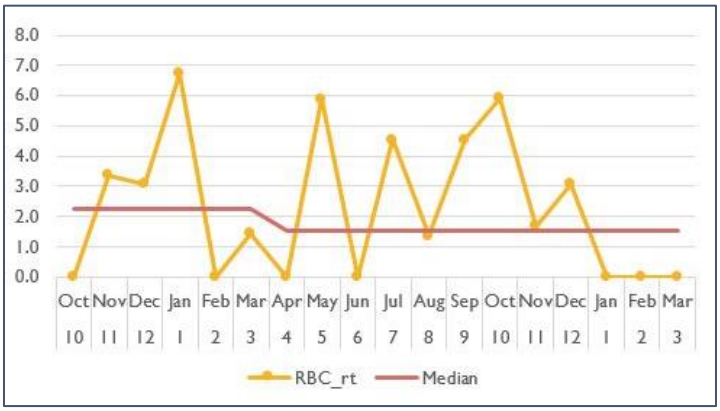

Figure 6 Massive Transfusion Median Run Chart.
Massive Transfusion was defined as transfusion of ≥ 4 units of pRBC. The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

Average ICU admission rates decreased from 2.9 per 1,000 deliveries to 1.5 with median decreases noted from 3.1 to 0.7 (see *Figure 7*). ICU admission rates showed a downward shift with six of the last seven months of the performance period realizing zero maternal ICU admissions (see *Figure 8*). Wider control limits were noted during the performance period likely due to a low number of qualifying events.

Figure 7 Maternal ICU Admission Rate Control Chart.
The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

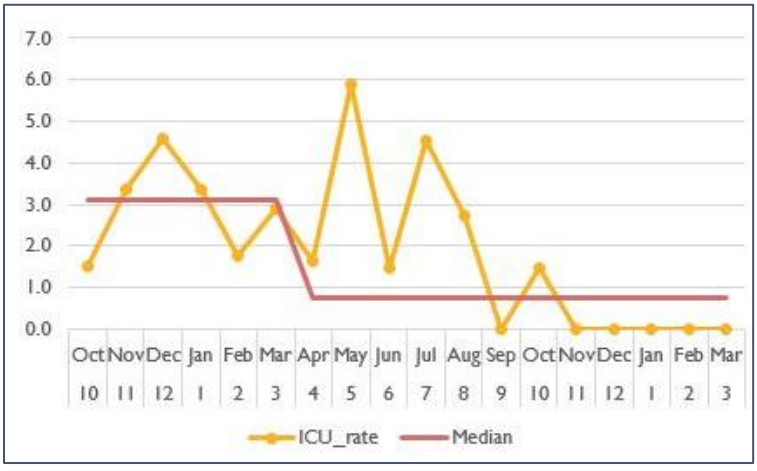

Figure 8 Maternal ICU Admission Rate Medan Run Chart.
The y-axis represents the rate of events per 1,000 deliveries. The x-axis represents months of data collection. Baseline period October 1, 2016 through March 31, 2017. Performance Period April 1, 2017 through March 31, 2018.

Discussion

Prior to completing this evaluation project it was assumed that if GNOSIS for OB were effective in preparing the care teams to more successfully manage OB hemorrhage, some cases of OB hemorrhage would be prevented, emergency interventions would be expedited through early identification of OB hemorrhage, and the need for massive transfusion (≥ 4 units pRBCs) and/or admission to the ICU would be avoided. These assumptions were supported through internal benchmarking. Internal benchmarking was realized by comparing organizational data between baseline and performance periods.

Overall OB hemorrhage rates declined by 1.7 per 1,000 deliveries. For this health system averaging 7,500 deliveries per year that means about 13 OB hemorrhages were prevented. While this may not seem like a significant number, it was definitely impactful for those individual patients and for each of their families.

Fewer massive transfusions were required with zero cases identified for 5 consecutive months. Reducing massive transfusion reduces risks associated with blood transfusion for these maternal patients. Transfusion reactions range in severity from mild to severe (Mayo Clinic, 1998-2018). Mild allergic reactions are accompanied by fever, hives, and itching. More severe reactions include acute or delayed immune hemolytic reactions which are a result of poor blood type matching. Decreased use of blood products within OB benefitted others as it allowed this precious resource to be more available for other patients.

Early identification of OB hemorrhage and expedited, evidence-based interventions were validated through the downward shift in maternal ICU admissions following the intervention. Six of the last seven months of the performance period realized zero maternal ICU admissions.

Improved management of OB hemorrhage eliminated the need for this higher level of care and saved families from the trauma associated with ICU admission.

Looking beyond organizational performance to compare results with national standards can help identify additional opportunities for improvement. External benchmarking is the process of comparing organizational performance with that of other organizations across the country. National standards, if available, can guide assessment of organizational performance. Potential opportunities for additional improvement and celebration of successes were identified through this process.

National standards for PPH rates, massive transfusion, or maternal ICU admission were not available at the time of this project. Ahmadzia, Grotegut, and James (2016) provided some averages with which to compare performance from a cross-sectional review of U.S. national data from 2000 to 2012. Comparisons were limited by variations in data definitions. The average non-severe OB hemorrhage rate across the nation was reported as 24.2 per 1,000 deliveries while the organizational PPH rate, even with the improvement noted following the intervention, was 54.7 per 1,000. The authors defined non-severe PPH as "PPH not requiring blood transfusion" (p. S277) while the definition utilized to capture PPH rates within the organization was based on estimated blood loss and included cases requiring blood transfusion and those which did not. Review of individual OB hemorrhage cases is recommended to mine specific opportunities for clinical improvement (ACOG, 2016).

Postpartum transfusion rates across the nation average 4.8 per 1,000 deliveries (Ahmadzia, Grotegut, & James, 2016). It was unclear if this data point represented cases with any transfusion at all or if a certain number of blood products was needed to trigger inclusion in this data point. The organizational rate for massive transfusion ($\geq$4 units pRBC) of 2.2 per 1,000

deliveries is better than the 4.8 per 1,000 reported in the review. National rates of maternal ICU admission were not available for comparison at the time of this report. The organizational performance which supported zero ICU admissions 6 of the last 7 months of the performance period is worth celebrating.

Variations in data definitions for postpartum hemorrhage and massive transfusion made it challenging to know if comparisons outside the organization were equitable. To support more accurate and meaningful benchmarking, ACOG initiated an effort called reVITALize to standardize obstetric data definitions (Menard, Main, and Currigan, 2014). ACOG (2017) recently issued an updated practice bulletin on postpartum hemorrhage promoting alignment with the definition of postpartum hemorrhage set by reVITALize. Postpartum hemorrhage is now defined as "blood loss greater than or equal to 1,000 mL or blood loss accompanied by signs or symptoms of hypovolemia within 24 hours after the birth process regardless of route of delivery" (ACOG, 2017, p. e168). Standardizing the PPH definition will support more meaningful benchmarking in the future.

Implications for Practice

This evaluation project has several implications for practice. Tracking clinical outcomes validated the impact of implementation of GNOSIS for OB on patient care. The forth level of evaluation based on the Kirkpatrick Model supports measurement of targeted outcomes (Kirkpatrick Partners, 2009-2017). Similarly, the IHI Model for Improvement advocates for data collection to determine if a change is actually an improvement (IHI, 2017).

The question driving this project was as follows: "Within this organization's maternal population, how does implementation of GNOSIS for OB, within a blended learning environment, affect inpatient perinatal outcomes over the first six to twelve months?" Early

results show a downward shift in ICU admissions and massive transfusion likely indicating better management of OB hemorrhage. Continuing to track data over a longer period of time may help identify more significant improvements.

Data-driven education reduced waste by right-sizing training. GNOSIS for OB provided competency assessments and plotted out individualized learning paths for each participant. Rather than following a traditional education model requiring every participant to complete the full content, additional training was right-sized to the needs of the individual and their team. When compared to a traditional educational model, use of the GNOSIS for OB platform realized nearly $70,000 in savings for nursing education hours the first year following implementation.

The blended learning environment allowed leaders to scaffold additional layers of training based on the gaps identified through the competency assessment. Learning experiences were enriching as they built upon the experience and competency of the learners. Standards of care were reinforced as provider and nurse teams trained together to recognize and intervene more quickly and appropriately to keep patients safe during OB hemorrhage.

Conclusion

U.S. maternal morbidity and MMR are rising at astounding rates (WHO, 2015). Immediate action must be taken to eliminate preventable causes. Nursing leaders are well-positioned to lead changes that will mitigate gaps (IOM, 2011). New approaches to provider and clinician education can support improved safety and reduce errors (IOM, 2001).

The e-learning platform, GNOSIS for OB, within a blended learning environment, appears to be a viable option to educate health care providers and clinicians on best practice recommendations. GNOSIS for OB, coupled with clinical improvement plans using the Model for Improvement, may be effective in reducing maternal morbidity and MMR. Early results

within one organization shared in this report, validate improved perinatal outcomes following implementation of the e-learning program GNOSIS for OB. Slight reduction in overall OB hemorrhage rates as well as downward shifts in both massive transfusion and maternal ICU admission were noted. Completion of this doctoral project has provided essential data to guide leaders in evidence-based improvement efforts. Additional study is needed to further link GNOSIS for OB with reductions in maternal morbidity and MMR.

References

Advanced Practice Systems [APS]. (2017). GNOSIS/AWHONN Content Partnership. Retrieved from http://www.aps-web.com/awhonn/

Ahmadzia, H., Grotegut, C., & James, A. (2016). Rates of postpartum hemorrhage and related interventions: Unites States, 2000-2012. *American Journal of Obstetrics & Gynecology, 214,* S277.

Alfieri, J., Portelance, L., Souhami, L., Steinert, Y., McLeod, P., Gallant, F., & Artho, G. (2012). Development and impact evaluation of an e-learning radiation oncology module. *International Journal of Radiation Oncology, 82*(3), e573-e580.

Al-Kadri, H.M., Dahlawi, H., Airan, M.A., Elsherif, E., Tawfeeq, N., Mokhele, Y. . . . & Tamim, H.M. (2014). Effect of education and clinical assessment on the accuracy of post partum blood loos estimation. *BMC Pregnancy & Childbirth, 14*(110), 1-7.

American College of Obstetrics and Gynecology. (2014). Obstetric Data Definitions. Retrieved from http://www.acog.org/revitalize

American College of Obstetrics and Gynecology. (2015). ACOG statement on maternal mortality. Retrieved from http://www.acog.org/About-ACOG/News-Room/Statements/2015/ACOG-Statement-on-Maternal-Mortality

American College of Obstetrics and Gynecology. (2016). Obstetric care consensus: Severe maternal morbidity: Screening and review. Retrieved from https://www.acog.org/Clinical-Guidance-and-Publications/Obstetric-Care-Consensus-Series/Severe-Maternal-Morbidity-Screening-and-Review

American College of Obstetrics and Gynecology. (2017). ACOG practice bulletin: Postpartum hemorrhage. *Obstetrics & Gynecology, 130*(4), e168-e186.

Bandla, H., Franco, R., Simpson, D., Brennan, K., McKanry, J., & Bragg, D. (2012). Assessing learning outcomes and cost effectiveness of an online sleep curriculum for medical students. *Journal of Clinical Sleep Medicine, 8*(4), 439-443.

Bergh, A.M., Baloyi, S., & Pattinson, R.C. (2015). What is the impact of multi-professional emergency obstetric and neonatal care training? *Best Practice & Research Clinical Obstetrics and Gynaecology, 29*, 1028-1043. doi: 10.1016.j.bpobgyn.2015.03.017

Bingham, D. (2012). Obstetric hemorrhage-related maternal mortality and morbidity. *Journal of Women's Health, 21*(9), 901-902. doi: 10.1089/jwh.2012.3873

Bingham, D., & Jones, R. (2012). Maternal death from obstetric hemorrhage. *Journal of Obstetrics, Gynecology, and Neonatal Nursing, 41*, 531-539. doi: 10.1111/j.1552-6909.2012.01372.x

Callaghan, W.M., Grobman, W.A., Kilpatrick, S.J., Main, E.K., & D'Alton, M. (2014). Facility-based identification of women with severe maternal morbidity. *Obstetrics & Gynecology, 123*(5), 978-981.

Centers for Disease Control and Prevention (2017). Pregnancy Mortality Surveillance System. Retrieved from http://cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html

Chao, H., Kaas, M., Su, Y., Lin M., Huang, M., & Wang, J. (2016). Effects of the advanced innovative Internet-based communication education program on promoting communication between nurses and patients with dementia. *The Journal of Nursing Research, 24*(2), 163-172. doi: 10.1097/jnr.0000000000000109

Clarke, S. (2013). Safety leadership: A meta-analytic review of transformational and transactional leadership styles as antecedents of safety behaviours. *Journal of Occupational and Organizational Psychology, 86, 22-49.*

Davies, S., Hauck, Y., Bayes, S., Barrett, T., & Jones, J. (2013). Australian maternity health professionals' experience of an e-learning fetal surveillance package. *Evidence Based Midwifery, 11*(4), 138-142.

Draycott, T.J., Collins, K.J., Crofts, J.F., Siassakos, D., Winter, C., Weiner, C.P., & Donald, F. (2015). Myths and realities of training in obstetric emergencies. *Best Practice & Research Clinical Obstetrics and Gynaecology, 29*, 1067-1076. doi: 10.1016/j.obgyn.2015.07.003

Durmaz, A., Dicle, A., Cakan, E. (2012). Effect of screen-based computer simulation on knowledge and skill in nursing students' learning of preoperative and postoperative care management. *Computers, Informatics, Nursing, 30*(4), 196-203. doi: 10.1097/NCN.0b013e3182419134

Egenberg, S., Masenga, G., Bru, L.E., Eggebo, T.M., Mushi, C., Massay, D., & Oian, P. (2017). Impact of multi-professional, scenario-based training on postpartum hemorrhage in Tanzania: A quasi-experimental, pre- vs. post-intervention study. *BMC Pregnancy and Childbirth, 17(287),* 1-11. doi: 10.1186/s12884-017-1478-2

Einerson, B.D., Miller, E.S., & Grobman, W.A. (2015). Does a postpartum hemorrhage patient safety program result in sustained changes in management and outcomes? *American Journal of Obstetrics & Gynecology, 212*(2), 140-144

Fahey, J. (2014). The recognition and management of intrapartum fetal heart rate emergencies: Beyond definitions and classification. *Journal of Midwifery & Women's Health, 59*(6), 616-623. Doi: 10.1111/jmwh.12256

Garrard, J. (2016). *Health sciences literature review made easy: The matrix method* (5th ed.). Burlington, MA: Jones & Bartlett.

Geller, S.E., Koch, A.R., Martin, N.J., Rosenberg, D., & Bigger, H.R. (2014). Assessing preventability of maternal mortality in Illinois: 2002-2012. *American Journal of Obstetrics & Gynecology, 211*(6), 698.e1-698.e11

George, A., Duff, M., Ajwani, S., Johnson, M., Dahlen, H. Blinkhorn, A., . . . Bhole, S. (2012). Development of an online education program for midwives in Australia to improve perinatal oral health. *The Journal of Perinatal Education, 21*(2), 112-122. doi: 10.1981/1058-1243.21.2.112

Grobman, W.A., Bailit, J.L., Rice, M.M., Wapner, R.J., Reddy, U.M., Varner, M.W. . . . Van Dorsten, J.P. (2014). Frequency of and factors associated with severe maternal morbidity. *Obstetrics & Gynecology, 123*(4), 804-810. doi: 10.1097/aog.0000000000000173

Hards, A., Davies, S., Salman, Al, Erik-Soussi, M., & Galki, M. (2012). Management of simulated maternal cardiac arrest by residents: Didactic teaching versus electronic learning. *Canadian Journal of Anesthesia, 59,* 852-860. doi: 10.1007/sl12630-012-9752-2

Hartwig, S., & Schwartz, P. (2014). Striving to attain high reliability in perinatal services: Perinatal safety SMART Lean process improvement. *Journal of Obstetrics, Gynecology, and Neonatal Nursing, 43,* S46-S47. doi: 10.1111.1552-6909.12352

HealthStream (2018). With maternal mortality rates on the rise, OB risk must be a priority. Retrieved from https://www.healthstream.com/docs/default-source/default-document-library/article--ob-risk-must-be-a-priority.pdf?Status=Temp&sfvrsn=2

Institute for Healthcare Improvement (IHI). (2017). Open School. Retrieved from http://app.ihi.org/lmsspa/#/6cb1c614-884b-43ef-9abd-d90849f183d4

Institute of Medicine (IOM). (1999). To err is human. Retrieved from http://www.nationalacademies.org/mwg-internal/de5fs23hu73ds/progress?id=K3pJ08V922YmtR9Y0QQPCZIFvTtDrcRH8NFm1c-4H9E,&dl

Institute of Medicine (IOM), Committee on Quality of Healthcare in America. (2001). *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington D.C.: National Academies Press.

Institute of Medicine (IOM). (2011). Transforming Leadership. In Institute of Medicine of the National Academies, *The future of nursing: Leading change, advancing health* (pp 221-254). Washington, DC: The National Academies Press.

Kirkpatrick Partners. (2009-2017). The Kirkpatrick Model. Retrieved from https://www.kirkpatrickpartners.com/Our-Philosophy/The-Kirkpatrick-Model

Kilpatrick, S.J., Prentice, P., Jones, R.L., & Geller, S. (2012). Reducing maternal deaths through state maternal mortality review. *Journal of Women's Health, 21*(9), 905-909. doi: 10.1089/jwh.2011.3398

Kilpatrick, S.J., Berg, C., Bernstein, P., Bingham, D., Delgado, A., Callaghan, W.M. . . . & Harper, M. (2014). Standardized severe maternal morbidity review. *Obstetrics & Gynecology, 124*(2), 361-366.

Knowles, M., Holton III, E., & Swanson, R. (1973). *The adult learner: The definitive classic in adult education and human resource development, 6th ed.* Amsterdam: Elsevier.

Kominiarek, M.A., Scott, S., Koch, A., Zeschke, M., Cordova, Y., Ravangard, S.F. . . . & Geller, S. (2017). Preventing maternal morbidity from obstetric hemorrhage: Implications of a provider training initiative. *American Journal of Perinatology, 34,* 74-79.

Kramer, M.S., Berg, C., Abenhaim, H., Dahhou, M., Rouleau, J., Mehrabadi, A., & Joseph, K.S. (2013). Incidence, risk factors, and temporal trends in severe postpartum hemorrhage. *American Journal of Obstetrics & Gynecology, 209*(5), 449.e1-449.e7. doi: 10.1016/j.ajog.2013.07.007

Lloyd, R. (2004). *Quality health care: A guide to developing and using indicators.* Sudbury, Massachusetts: Jones and Bartlett Publishers

MacDorman, M., Declercq, E., Cabral, H., & Morton, C., (2016). Recent increases in the U.S. maternal mortality rate. *Obstetrics & Gynecology, 128*(3), 447-455.

Mayo Clinic. (1998-2018). Blood Transfusion. Retrieved from https://www.mayoclinic.org/tests-procedures/blood-transfusion/about/pac-20385168

Menard, M. K., Main, E., Currigan, S. (2014). Executive summary of the reVITALize initiative. *Obstetrics & Gynecology, 124,* 150-153.

Monod, C., Voekt, C., Gisin, M., Gisin, S., & Hoesli, I.M. (2014). Optimization of competency in obstetrical emergencies: A role for simulation training. *Archives of Gynecology and Obstetrics, 289,* 733-738. doi: 10.1007/s00404-013-3111-6

Nageotte, M., Tomlinson, M., & O'Keefe, M. (2016). A credentialing test for EFM. *Contemporary OB/GYN, May,* 19-24.

Nelissen, E., Ersdal, H., Mduma, E., Evjen-Olsen, B., Twisk, J., Broerse, J. . . . & Stekelenburg, J. (2017). Clinical performance and patient outcome after simulation-based training in prevention and management of postpartum haemorrhage: An educational intervention study in a low-resource setting. *BMC Pregnancy and Childbirth, 17(301)*, 1-9. doi: 10.1186/s12884-017-1481-7

Pappas, C. (2013, May 9). The adult learning theory – Andragogy – of Malcolm Knowles [Web log post]. Retrieved from https://elearningindustry.com/the-adult-learning-theory-andragogy-of-malcolm-Knowles

Pape-Koehler, C., Immenroth, M., Sauerland, S., Lefering, R., Lindlohr, C., Toaspern, J., & Heiss, M. (2013). Multimedia-based training on Internet platforms improves surgical performance: A randomized controlled trial. *Surgical Endoscopy*, 27, 1737-1747. doi: 10.10007/s00464-012-2672-y

Pilcher, J. (2013). Learning preferences among neonatal and maternal child nurses. *Neonatal Network, 32*(2), 117-119. Doi 10.1891/0730.0832.32.2.117

Santos, P., Ritter, G., Hefele, J. Hendrich, A., & Kocot, C. (2015). Decreasing intrapartum malpractice: Targeting the most injurious neonatal adverse events. *Journal of Healthcare Risk Management, 34*(4), 20-27. doi: 10.1002/jhrm

Shields, L.E., Weisner, S., Fulton, J., & Pelletreau, B. (2015). Comprehensive maternal hemorrhage protocols reduce the use of blood products and improve patient safety. *American Journal of Obstetrics & Gynecology, 212*(3), 272-280

Shoushtarian, M., Barnett, M., McMahon, F., & Ferris, J. (2014). Impact of introducing practical obstetric multi-professional training (PROMPT) into maternity units in Victoria, Australia. *Brittish Journal of Obstetrics and Gynecology, 121*, 1710-1719. doi: 10.1111/1471-0528.12767

Simpson, K.R., Creehan, P.A. (2014). Postpartum hemorrhage. In AWHONN'S *Perinatal Nursing*. (4th ed.). (pp. 549-560). Philadelphia Pa: Wolters Kluwer/Lippincott Williams & Wilkins.

Sinclair, P., Kable, A., Levett-Jones, T., & Booth, D. (2016). The effectiveness of Internet-based e-learning on clinical behaviour and patient outcomes: A systematic review. *International Journal of Nursing Studies, 57*, 70-81. Doi: 10.1016/j.ijnurstu.2016.01.011

Skupski, D.W., Brady, D., Lowenwirt, I.P., Sample, J., Lin, S.L., Lohana, R., & Eglinton, G.S. (2017). Improvement in outcomes of major obstetric hemorrhage through systematic change. *Obstetrics & Gynecology, 130(*4), 770-777. doi: 10.1097/aog.0000000000002207

Spitzer, R.F., Steele, S.J., Caloia, D., Thorne, J., Bocking A.D., Christoffersen-Deb, A. . . . & Omenge, E. (2014). One-year evaluation of the impact of an emergency obstetric and neonatal care training program in Western Kenya. *International Journal of Gynecology and Obstetrics, 127*, 189-193. doi: 10.1016/j/ijgo.2014.05.023

Subramanian, A., Timberlake, M., Mittakanti, H., Lara, M., & Brandt, M. (2011). Novel educational approach for medical students: Improved retention rates using interactive medical software compared with traditional lecture-based format. *Journal of Surgical Education, 69*(2), 253-256. doi: 10.1016/j.jsurg.2011.12.007

The Joint Commission (TJC). (2016). Sentinel Event Policy. Retrieved from https://www.jointcommission.org/assets/1/6/CAMH_24_SE_all_CURRENT.pdf

Tomlinson, J., Shaw, T., Munro, A., Johnson, R. Madden, D., Phillips, R., & McGregor, D. (2013). How does tele-learning compare with other forms of education delivery? A systematic review of tele-learning educational outcomes for health professionals. *New South Wales Public Health Bulletin, 24*(2), 70-75. doi: 10.1071/NB12076

US Department of Health and Human Services. (n.d.). Guidance regarding methods for de-identification of protected health information in accordance with the health insurance portability and accountability act (HIPAA) privacy rule. Retrieved from http://www.hhs.gov/ocr/privacy/hipaa/understanding/coveredentities/De-identification/guidance.html

Van de Ven, J., Fransen, A.F., Schuit, E., van Runnard Heimel, P.J, Mol, B.W., & Oei, S.G. (2017). Does the effect of one-day simulation team training in obstetric emergencies decline within one year? A post-hoc analysis of a multicenter cluster randomized controlled trial. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 216,* 79-84. doi: 10.1016/j.ejogrb.2017.01.020

Veteran's Administration National Center for Patient Safety. (2015). RCA tools. Retrieved from https://www.patientsafety.va.gov/docs/joe/rca_tools_2_15.pdf

Wagner, B., Meirowitz, N. Shah, J., Nanda, D. Reggio, L., Cohen, P…. Abrams, K. (2012). Comprehensive perinatal safety initiative to reduce adverse obstetric events. *Journal of Healthcare Quality, 34*(1), 6-15.

World Health Organization. (2015). Trends in maternal mortality: 1990-2015. Retrieved from http://apps.who.int/iris/bitstream/10665/193994/1/WHO_RHR_15.23_eng.pdf?ua=1

Appendix 1 Human Subjects Forms

The University of Kansas Medical Center

Human Research Protection Program

March 1, 2018

Project Title: Evaluating the Effect of an Online, Assessment-driven Learning Platform for Obstetric Providers and Nurses
Institutional Contacts: Julya Miner
Department: School of Nursing
Determination: Not human subjects research

Thank you for your submission. This is to certify that the above referenced project has been evaluated by the KUMC Human Research Protection Program (HRPP). Your proposal is deemed to constitute quality improvement/healthcare oversight. Therefore, there is no requirement for IRB approval.

This project involves a secondary analysis of data from the [redacted] Data were collected by [redacted] as a performance improvement project and only de-identified data will be given to KUMC. For these reasons, your analysis does not involve human subjects and does not require IRB review.

Please note that if you revise your activities to use identifiable data to answer a research question, you should contact our office immediately. If this were to occur, the HRPP would re-evaluate your project's regulatory status. Please feel free to contact our office with any questions.

[redacted]
Kyle Stephens, MA, CIP
Assistant Director, Human Research Protection Program

Mail-Stop 1032, 3901 Rainbow Blvd., Kansas City, KS 66160
Phone: (913) 588-0942 Fax: (913) 588-5771 kblackwe@kumc.edu

[redacted]

February 19, 2018

Julya Miner
[redacted]
Dr. Laura Tivis
[redacted]

Re: IRB Determination: ***Evaluating the Effect of an Online, Assessment-Driven Learning Platform for Obstetric Providers and Nurses***

Dear Ms. Miner,

I appreciate your request for IRB determination regarding protection of the rights and welfare of subjects involved in the above referenced project.

The project seeks to improve clinical care. The study is not designed to develop or contribute to generalizable knowledge. Instead, the project follows an evidence-based approach to using information to improve clinical outcomes. Individual identifying information will not be included in the project. Subjects are not randomized to different treatments or interventions. There are no non-standard practices, interventions or treatments that are part of the study. The project does not entail greater risk to individuals than would normally be anticipated under the standard-of-care.

The study meets criteria for a Performance Improvement (PI) project and not for research involving human subjects covered by 45 CFR part 46. The project does not require IRB approval. Results from the study may be presented or published outside of St. Luke's as long as the project is not referred to as research.

Additional Notes:

1. This determination could be affected by substantive changes in the project design, subject populations, or identifiability of data. If the project changes in any substantive way, please contact our office for clarification.

2. Please note that federal regulators have made it clear that any publication describing a project as research must have prior IRB review and approval. Therefore, projects determined to be Evidence Based Practice (EBP)/Performance Improvement (PI)/Program Evaluation, etc., initiatives should not be published as research.

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3. Also, some journals require evidence of IRB review if an activity discussed in an article is described as research. Please take caution as to the verbiage utilized to describe the activities outlined in the publication.

Thank you again for your inquiry. If you have further questions, you may call the IRB Office for clarifications at (208)381-1406.

Sincerely,

[redacted]

W. Mark Roberts, MD, MMM
Medical Director for Research and Medical Education
[redacted]

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