

QUANTITATIVE BLOOD LOSS: A QUALITY IMPROVEMENT PROJECT IN A RURAL
PERINATAL SURGICAL UNIT

by

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DEDICATION

I dedicate this manuscript and the entire journey to earning my Doctor of Nursing Practice to my incredible husband, Brice Conrad Normandeau. I would not have reached this moment without your steady encouragement and unwavering support. You held me through the moments I felt lost, defeated, exhausted, and overwhelmed. When I doubted myself, you pulled me close and reminded me I would make it through. Thank you for giving me encouragement and the space to study and write on evenings, weekends, holidays, after long workdays, and even during our vacations. These past three years have taken so much out of us, and I am looking forward to making up for all the time we missed. I am here today because of your love, support, and belief in me.

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ABSTRACT

BACKGROUND: Quantitative blood loss (QBL) provides a more accurate assessment of intraoperative blood loss during cesarean delivery than visual estimation. Reliance on visual estimation can delay recognition of postpartum hemorrhage, a leading cause of preventable maternal morbidity and mortality. Accurate and timely measurement is especially critical in low-volume rural hospitals, where limited resources and delayed response time can have significant consequences.

LOCAL PROBLEM: At the project site, a rural critical access hospital (CAH) in northwest Montana, QBL was not performed during cesarean deliveries, representing a deviation from established standards of obstetric care.

METHODS: The project used the Institute for Healthcare Improvement Model for Improvement to implement a standardized QBL protocol, combining workflow changes, staff education, and use of a QBL worksheet to support accurate measurement and documentation during cesarean deliveries. Data were collected through electronic health record audits at scheduled intervals, and iterative Plan-Do-Study-Act cycles guided adjustments.

INTERVENTION: Two interventions were initiated: Surgical staff education on QBL and a QBL worksheet listing the dry weights of all materials.

RESULTS: The project aims were partially achieved, with 82% of staff completing QBL education. Three cesarean deliveries occurred during implementation; all utilized the QBL worksheet, and corresponding QBL values were documented in the electronic health record.

CONCLUSION: CAHs can successfully integrate standardized QBL processes into cesarean workflows with minimal disruption. Sustained use of QBL supports earlier recognition of postpartum hemorrhage, improving the quality of care, maternal outcomes, and patient safety.

CHAPTER ONE

REVIEW OF THE LITERATURE

Introduction

Background

Promoting safe childbirth is a central objective in maternal healthcare, yet preventable complications such as postpartum hemorrhage (PPH) continue to compromise maternal outcomes, particularly after cesarean delivery and in resource-limited settings (American Society of Anesthesiologists [ASA], 2023; Belfort, 2025). PPH is defined as blood loss of 1,000 mL or more within the first 24 hours after birth, accompanied by signs and symptoms of low blood volume (American College of Obstetricians and Gynecologists [ACOG], 2019). PPH is commonly classified by the “4 Ts”: Tone (uterine atony, the most frequent cause), Trauma (cervical or vaginal lacerations, uterine rupture, hematomas), Tissue (retained placental fragments, blood clots, or placenta accreta spectrum), and Thrombin (coagulopathies that impair clot formation). PPH remains one of the most critical threats to maternal health, contributing to 11% of maternal deaths in the United States (U.S.), yet 54-93% of these deaths are preventable (ACOG, 2019). Despite medical advancements, the U.S. leads industrialized nations with a maternal death rate of 17.6 per 100,000 live births (Association of Women’s Health, Obstetric, and Neonatal Nurses [AWHONN], 2021). Every woman giving birth carries a risk of PPH, with approximately 40% of cases occurring in women classified as low-risk (ACOG, 2019). Cesarean delivery is associated with a higher risk of PPH than vaginal birth, and occurs in more than 5-10% of cesarean deliveries (Belfort, 2025; Hosseinzadeh et al., 2023). The surgical nature of

cesarean birth complicates accurate estimation of blood loss, which can delay recognition and treatment (Belfort, 2025). Effectively managing PPH requires teamwork and an accurate assessment of blood loss, highlighting the importance of adopting evidence-based approaches that promote early detection and prompt treatment (AWHONN, 2021).

Evidence-Based Proposed Solution

Quantitative blood loss (QBL) is a standardized, evidence-based, and objective method for measuring blood loss during and after childbirth. QBL involves the use of calibrated drapes, gravimetric analysis of blood-soaked materials, canisters, and volumetric measurement of suctioned fluids to provide precise assessments (ACOG, 2019). Unlike estimated blood loss (EBL), which relies on subjective visual assessment and is prone to inaccuracy, QBL provides an accurate and consistent evaluation of blood loss (ACOG, 2019; Alliance for Innovation on Maternal Health [AIM], 2022; AWHONN, 2021; California Maternal Quality Care Collaborative [CMQCC], 2022).

The Joint Commission supports QBL as an effective method for improving maternal health outcomes and requires hospitals to adopt evidence-based strategies aimed at reducing maternal morbidity and mortality (Joseph et al., 2020). Building on this, national and state-level initiatives, such as the Alliance for Innovation on Maternal Health (AIM), the American College of Obstetricians and Gynecologists, the Association of Women's Health Obstetric and Neonatal Nurses, and the California Maternal Quality Care Collaborative (CMQCC), along with local programs like Montana Obstetric Maternal Safety (MOMS), actively promote QBL implementation in both vaginal and cesarean births. Several of these organizations also provide obstetric hemorrhage bundles, which are standardized, evidence-based practice guidelines

designed to improve the recognition, response, and prevention of severe bleeding during and after childbirth (AIM, 2022). The bundles enable healthcare teams to respond quickly and consistently to PPH, thereby reducing complications and saving lives (AIM, 2022; CMQCC, 2022).

Rural hospitals may face barriers to the adoption of QBL, including intervention-associated costs, limited resources and staff, inadequate staff training, and a lack of buy-in from both providers and the organization as a whole (Kram et al., 2024). To assist rural hospitals with associated costs and to support organizational efforts, several programs offer implementation assistance and funding. For example, the MOMS program provides grants, education, and training to rural hospitals in Montana. The goal of MOMS is to enhance maternal care, improve emergency preparedness for obstetric complications, and promote the implementation of best practices that reduce maternal morbidity and mortality in underserved communities (MOMS, 2020). The scoping review aims to summarize the literature and outcomes associated with QBL protocols and obstetric safety bundles to reduce PPH after cesarean deliveries.

Methods

The scoping review employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework to guide article inclusion. The review followed a systematic five-step process consisting of defining the research question, identifying relevant studies, screening and selecting appropriate articles, extracting and compiling data, and synthesizing and reporting the findings.

Search strategies

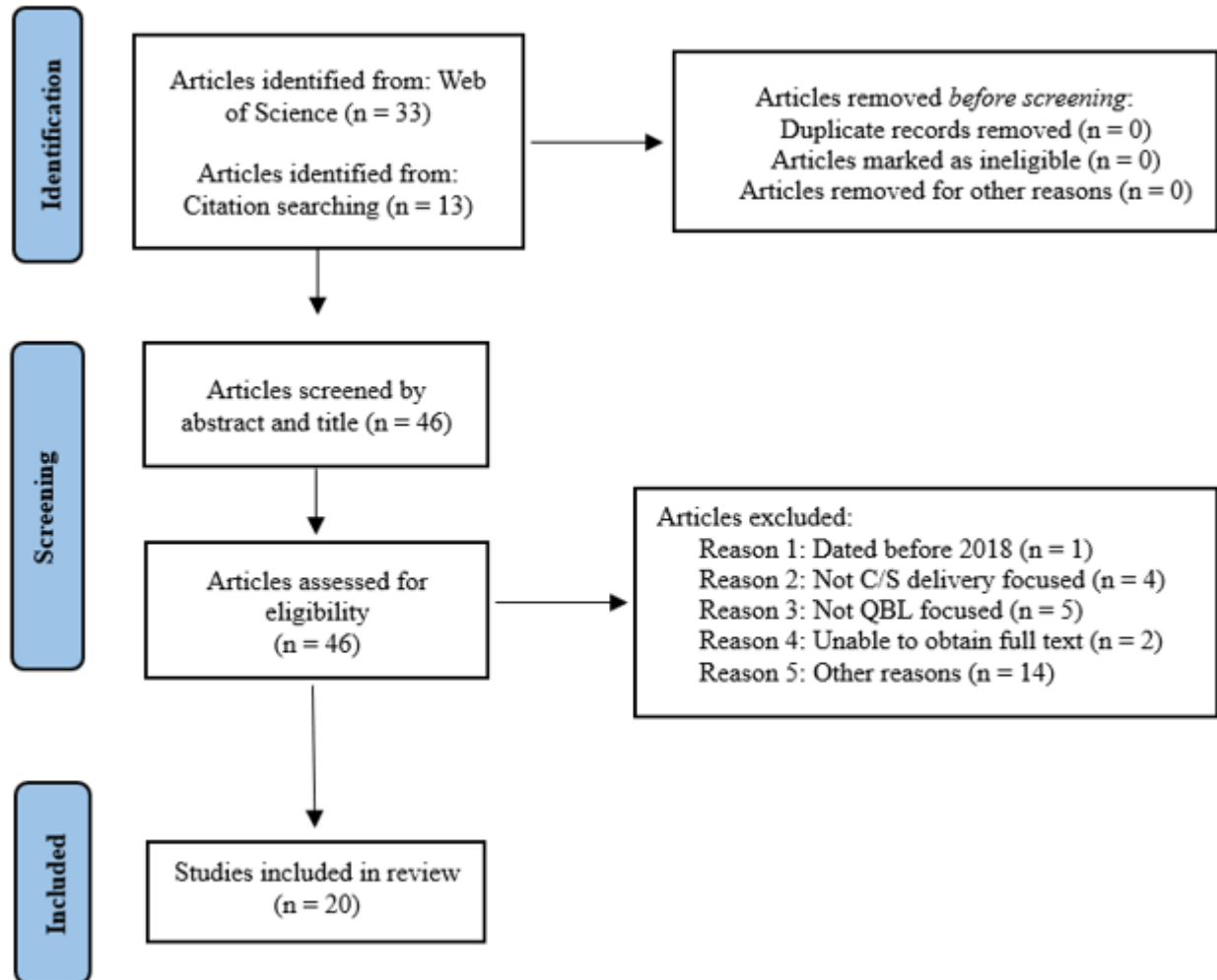
To identify relevant literature for this scoping review, a comprehensive search was conducted using the Web of Science electronic database. The search process was developed in collaboration with the librarian at Montana State University to ensure methodological rigor and completeness. The search was done on September 16, 2025. Keywords included: “blood loss,” or “estimated blood loss,” or “EBL,” or “quantification of blood loss,” or “quantitative blood loss” or “QBL,” or “hemorrhage,” or “obstetric hemorrhage,” or “postpartum hemorrhage,” or “Cesarean” or “Caesarean,” and “rural” to identify relevant peer-reviewed studies.

Inclusion Criteria

To be eligible for the scoping review, articles needed to meet the following criteria: (1) peer-reviewed publication; (2) published between 2019 and 2025; (3) written in English language; (4) full-text available online; and (5) presented outcomes that supported or challenged the use of QBL methods. Additional articles were identified through reference mining of included articles. Articles were excluded if the focus was solely on vaginal deliveries, relevance to QBL implementation was lacking, or clinical outcomes were not reported. These criteria aimed to ensure relevance to current practice and applicability to rural healthcare environments, where PPH present unique challenges.

Relevant reviews were identified through an initial screening of titles and abstracts. Subsequently, all accessible full-text articles were independently assessed by the author to determine eligibility based on predefined inclusion criteria. The detailed screening process is illustrated in Figure 1.

Figure 1: Study PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Flow Diagram



Results

The PRISMA framework guided the study selection process. A total of 33 articles were identified through the Web of Science electronic database, and an additional 13 articles were selected from the references of these articles. Following a comprehensive review of screening

titles and abstracts, 20 articles met the inclusion criteria and were included in the scoping review. Among these articles, there were two Level I studies one systematic review and one meta-analysis. Eight Level III studies included retrospective and prospective cohort studies, case-control studies, and cross-sectional studies. Additionally, three Level IV studies consisted of one descriptive longitudinal study, one qualitative descriptive study, and one retrospective observational study. Finally, seven Level V studies were identified, including one narrative review, four quality improvement projects, and two expert opinions. The selected articles reflect a diverse range of methodologies, perspectives, and clinical practice recommendations. The inclusion of quality improvement (QI) initiatives and expert consensus documents provided valuable context for QBL implementation strategies in rural settings.

Synthesis of the Literature

Three major themes emerged from the synthesis as they relate to cesarean delivery: effectiveness of QBL, implementation barriers and contextual challenges, and role of obstetric safety bundles and system-level support.

Theme One

Blosser et al. (2021) found QBL outperformed EBL in predicting the need for blood transfusion. Similarly, Bell et al. (2020) and Seacrist et al. (2019) reported QBL implementation led to reduced transfusion rates and improved clinical decision-making. Hire et al. (2020) further demonstrated QBL was associated with a lower incidence of PPH and fewer interventions than EBL. Khan et al. (2025) demonstrated EBL values during cesarean sections were significantly greater than those measured by QBL methods ($p = 0.016$), highlighting discrepancies between the two measurement techniques. Supporting these findings, ACOG (2019) and AWHONN

(2021) advocate for QBL as a more accurate method of assessing blood loss, enabling earlier detection and timely intervention to reduce maternal morbidity and mortality. Moreover, QBL not only reduces unnecessary treatments caused by the overestimations common with visual EBL but also identifies underestimations that could result in serious complications (Hire et al., 2020; Powell et al., 2020; Sleutel et al., 2021).

QBL provides a real-time, practical evaluation of hemorrhage, whereas hemoglobin laboratory tests detect blood loss only after a delay (Powell et al., 2022). Since hemoglobin levels often do not significantly drop until 24 to 48 hours postpartum, early testing underestimates the true extent of bleeding (Powell et al., 2022). QBL enables healthcare providers ability to detect excessive bleeding promptly and respond effectively, thereby contributing to improved maternal outcomes (Ruiz et al., 2023).

There are some potential limitations associated with QBL. Thurer et al. (2022) reported although gravimetric QBL is more accurate than visual estimation, it often overestimates blood loss compared to hemoglobin assays. Gravimetric measurement involves weighing blood-soaked materials and then subtracting the known dry weight of those same materials to determine the amount of blood loss. The difference in weight, measured in grams, directly corresponds to the volume of blood lost in milliliters; one gram of blood is equal to one milliliter. Notably, 20% of patients were mistakenly classified as having PPH despite actually experiencing lower blood loss (Thurer et al., 2022). Hemoglobin assay involves collecting all blood-soaked sponges and suction canister fluids after a cesarean delivery. Blood is rinsed from sponges using saline, while suction fluids are ready for analysis. These samples undergo a spectrophotometric hemoglobin assay, which measures hemoglobin concentration by light absorption at specific wavelengths

(Thurer et al., 2022). The total hemoglobin content is then used to determine the blood loss volume, providing a more accurate biochemical measurement than visual or gravimetric methods (Thurer et al., 2022).

While improving the accuracy of blood loss measurement remains essential, effective management of PPH also requires thorough assessment of individual risk factors. Although all women who give birth face some risk of PPH (ACOG, 2019), certain factors, including a history of PPH, multiple gestation, polyhydramnios, prolonged labor, use of oxytocin or other uterotonic agents, chorioamnionitis, operative vaginal delivery, cesarean birth, maternal obesity, and coagulation disorders, can increase this risk (AWHONN, 2021). PPH safety bundles are structured sets of evidence-based clinical practices designed to be implemented together to improve patient outcomes by standardizing prevention, early detection, and treatment strategies (AIM, 2022). The bundles incorporate staff training, education, drills, protocols, standardized QBL methods, and comprehensive patient risk assessments to guide timely, targeted interventions. As Włodarczyk et al. (2025) emphasized, combining precise blood loss measurement with risk factor identification enhances clinical management during cesarean sections, highlighting the critical role of validated, standardized QBL approaches in improving diagnostic accuracy and supporting personalized care.

Theme Two

The second theme identified barriers to implementing QBL protocols especially in rural settings. Rural hospitals face unique challenges, including limited staffing, inconsistent training, equipment shortages, low birth rates, and overall resource constraints (Kozhimannil et al., 2023). These limitations contribute to higher rates of severe maternal morbidity compared to urban

centers, underscoring the urgency of adopting standardized hemorrhage management practices (Kozhimannil et al., 2023). Hire et al. (2020) reported a 60% increase in timely activation of hemorrhage protocols following QBL implementation, though smaller facilities struggled with equipment availability. Vogel et al. (2024), Sleutel et al. (2021), and Joseph et al. (2020) found care bundles incorporating QBL shortened response times and increased clinician confidence. Joseph et al. (2020) demonstrated that introducing PPH safety bundles in a resource-limited hospital led to over 90% classification rates in hemorrhage risk assessments. However, both Joseph et al. (2020) and Dulaney et al. (2022) emphasized that without administrative support and ongoing education, QBL protocols may be inconsistently applied. Systemic barriers, including infrastructure gaps, funding limitations, lack of institutional support, and lower birth volumes, further complicate the adoption of standardized clinical procedures in rural hospitals (Bhatt et al., 2022; CMQCC, 2022; Kozhimannil et al., 2023). These factors create a complex environment in which implementing safety bundles and evidence-based protocols, typically designed for higher-resource settings, remains a significant challenge.

Theme Three

The final theme is supported by the ACOG (2019) and AWHONN (2021) guidelines, which both advocate for the integration of obstetric safety bundles. Obstetric safety bundles consist of structured, evidence-based clinical practices designed for coordinated implementation to standardize prevention, early detection, and PPH treatment strategies (AIM, 2022). These bundles incorporate staff training, education, drills, protocols, standardized QBL methods, and comprehensive patient risk assessments to enable timely and targeted interventions. While enhancing the accuracy of blood loss measurement is essential, effective management of PPH

also requires comprehensive assessment of individual risk factors. Although all women who give birth face some risk of PPH (ACOG, 2019), this risk is elevated by factors such as a history of PPH, multiple gestation, polyhydramnios, prolonged labor, use of oxytocin or other uterotonics, chorioamnionitis, operative vaginal delivery, cesarean birth, maternal obesity, and coagulation disorders (AWHONN, 2021). The quality improvement initiatives further highlight the critical roles of staff education, multidisciplinary stakeholder engagement, organizational buy-in, protocol development, implementation of QBL bundles, and strong leadership support in sustaining effective QBL practices, particularly within rural healthcare settings (Dulaney et al., 2022; Hendrixson et al., 2022; Joseph et al., 2020; Ladouceur & Goldort, 2019; Sleutel et al., 2021; Steinberg, 2019).

Discussion and Conclusion

The scoping review highlights the importance of QBL measurement and obstetric safety bundles in enhancing the recognition and management of PPH. Evidence consistently shows QBL provides a more accurate and objective assessment of blood loss than EBL, particularly during cesarean deliveries. QBL enhances clinical decision-making, reduces transfusion rates, and enables timely intervention (Bell et al., 2020; Blosser et al., 2021; Hire et al., 2020; Khan et al., 2025; Seacrist et al., 2019). Unlike delayed hemoglobin testing, QBL offers real-time evaluation, allowing prompt response and improved outcomes (Powell et al., 2022; Ruiz et al., 2023). Although gravimetric QBL may overestimate blood loss compared to hemoglobin assays, it remains a valuable tool when integrated into broader safety protocols (Thurer et al., 2022).

ACOG (2019) and AWHONN (2021) endorse obstetric safety bundles to standardize prevention, early detection, and treatment. These bundles incorporate staff training, education,

drills, QBL methods, and individualized risk assessments to support consistent, effective responses (AIM, 2022; CMQCC, 2022). Given that nearly 40% of PPH cases occur in low-risk patients (ACOG, 2019), risk stratification remains essential (AWHONN, 2021).

Rural hospitals face barriers to implementation, including staffing shortages, limited training, equipment constraints, and low birth volumes (Bhatt et al., 2022; Kozhimannil et al., 2023). Quality improvement initiatives emphasize the need for leadership, institutional support, and multidisciplinary engagement (Dulaney et al., 2022; Joseph et al., 2020; Sleutel et al., 2021). Programs like MOMS offer funding and tailored support to help rural facilities overcome these challenges (MOMS, 2020).

In conclusion, QBL and obstetric safety bundles are essential, evidence-based strategies for reducing maternal morbidity and mortality from PPH. Widespread adoption, particularly in rural and resource-limited settings, requires targeted investment, training, and policy support to ensure equitable access to life-saving care.

CHAPTER TWO

QUALITY IMPROVEMENT PROPOSAL

Introduction and ProblemIntroduction

Obstetric hemorrhage remains the leading cause of maternal mortality, accounting for approximately 27% of deaths during pregnancy and the following six weeks (Anderer, 2025; World Health Organization, 2025). The elevated burden is compounded by the rising global rate of cesarean deliveries, which carry distinct hemorrhagic risks (Alipour et al., 2022). Cesarean delivery significantly increases the risk of PPH due to multiple physiological and procedural factors. Cesarean deliveries account for approximately 30% of all live births in the United States (Iddrisu & Khan, 2021). The average blood loss during cesarean delivery is approximately 1,000 mL, which is twice the amount lost during vaginal births, thereby increasing the risk of PPH (Wlodarczyk et al., 2025). Uterine atony, the failure of the uterus to contract effectively after delivery, is more common in cesarean births and is the leading cause of PPH in cesarean deliveries (Alonso-Burgos et al., 2024). Surgical trauma to uterine and pelvic vessels further elevates bleeding risk, especially in cases involving placenta accreta spectrum disorders, which are more prevalent among women with prior cesareans (Alonso-Burgos et al., 2024). Additionally, general anesthesia used during cesarean procedures may impair uterine contractility, compounding the risk (Iddrisu & Khan, 2021). By integrating QBL measurement into clinical practice, especially in rural hospitals, providers can enhance early detection and

management of PPH, ultimately improving maternal outcomes and reducing preventable morbidity and mortality in underserved populations.

Montana has the sixth-highest maternal mortality rate in the U.S., with a maternal morbidity rate exceeding the national average by 35% (MOMS, 2020). Pregnant women in rural Montana are 1.9 times more likely to experience maternal morbidity, while Native American women face three times the risk compared to Caucasian women (Glover, 2022; MOMS, 2020). Geographic isolation, provider shortages, and inconsistent reporting systems contribute to underreporting of maternal morbidity and mortality, particularly among rural and Indigenous populations (Rural Health Information Hub, 2023; Montana Department of Public Health and Human Services, 2023).

Problem Statement

The identified problem at the project site is the lack of standardized QBL measurement across delivery types, particularly during cesarean sections in the perinatal surgical unit. The project site is a 25-bed critical-access hospital (CAH) in rural northwest Montana. The hospital is physically located on an Indian Reservation; however, it is not a part of Indian Health Services or Tribal Health. At the project site QBL is routinely assessed and documented during all vaginal deliveries. However, QBL is not assessed or documented during cesarean deliveries in the perinatal surgery unit, creating a defined gap in clinical practice. Failure to assess QBL in rural settings, where surgical births carry elevated risk for PPH and resources are limited, delays recognition and management of excessive blood loss. As a result, there is an increased risk of adverse maternal outcomes (ACOG, 2019; Bell et al., 2020). Implementing QBL during cesarean deliveries enhances nurse recognition of excessive blood loss and supports timely intervention

and prevention (ACOG, 2019; AWHONN, 2021; Bhatt et al., 2022; Blosser et al., 2021; Hendrixson et al., 2022; Hire et al., 2020; Seacrist et al., 2019; Sleutel et al., 2021). Addressing the gap will strengthen maternal care practices and promote safer surgical birth outcomes.

Organizational Microsystem Assessment

The obstetric unit primarily serves Caucasian and Native American women. Of the 51 deliveries recorded in 2024, 29 women identified as Caucasian, 20 as Native American, and two did not specify race. The nearest higher-level care facility, which provides specialized or intensive medical services beyond what the local CAH can offer, is approximately 60 miles away and creates significant challenges in accessibility, resource demands, and financial burden.

The project site's information technology (IT) specialist conducted a quantitative chart review and determined over the past five years, the site averages approximately 75 deliveries annually. In 2024, 51 births were recorded. Of these, 12 were cesarean deliveries, including both primary and repeat procedures. Two PPH cases were identified in 2024, both associated with cesarean delivery. Representing a PPH rate of 3.92% across all delivery types and a higher rate of 16.67% among cesarean births, highlighting the need for targeted interventions in cesarean deliveries.

A collaborative discussion with qualitative feedback from the Operating Room (OR) and Obstetrics (OB) managers confirmed the need to implement national guidelines from ACOG, AWHONN, and the Association of Perioperative Registered Nurses (AORN). National guidelines recommend replacing EBL with QBL for all births. The conversation about the national guidelines with the OB and OR manager emphasized the variability and frequent inaccuracies in EBL reporting, including both underestimation and overestimation. Currently,

obstetric registered nurses (OB RNs) perform QBL assessments during all vaginal deliveries and continue monitoring QBL for six hours postpartum. Since implementing vaginal birth QBL, there were no documented PPH cases after vaginal delivery in 2024 (Anonymous, personal communication, October 15, 2025). In contrast, the perinatal surgical unit still relies on EBL instead of QBL for cesarean deliveries during both the procedure and recovery phase.

Project stakeholders include the project lead, a Doctor of Nursing Practice (DNP) student, the OB and OR managers, with additional stakeholders comprising three family practice obstetric providers, six OR RNs, three certified registered nurse anesthetists (CRNAs), two surgical technologists, and two IT specialists. While the department culture generally supports process improvement, some staff have expressed concerns about potential short-term impacts on efficiency. The nursing-led implementation will proceed without requiring a physician's order, with CRNAs and surgical team members collaborating to shift from EBL to a team-based, measured approach.

Quality Improvement Framework

The QI team will implement QBL measurement during cesarean deliveries, using the Institute for Healthcare Improvement (IHI) Model for Improvement as the QI framework. The structured, evidence-based framework is well-suited for rural CAHs with limited resources. The team will use the IHI model's three guiding questions: What are we trying to accomplish? How will we know a change is an improvement? What changes can we make that will result in improvement? (Institute for Healthcare Improvement [IHI], n.d.; Ogrinc et al., 2022). By answering these questions, the team will be able to set goals, select interventions, and evaluate progress. Through standardization of QBL for all cesarean births, the team aims to improve the

accuracy of blood loss measurement, resulting in the potential to increase early detection of PPH, a leading cause of maternal morbidity and mortality. Given the increased risk of PPH in surgical deliveries and the hospital's geographic isolation, timely and accurate assessment is critical.

The QI team will monitor documentation rates, staff adherence to QBL, and maternal outcomes. The team will test changes such as staff training, workflow redesign, and equipment upgrades through iterative Plan-Do-Study-Act (PDSA) cycles. After validation, the changes will be sustained through infrastructure support, real-time feedback, and a culture of continuous learning. The IHI framework assists QBL in becoming an embedded practice, strengthening maternal care in an underserved setting. For the QI initiative, the PDSA framework was selected due to its adaptability, low implementation cost, and suitability for resource-constrained environments such as rural CAHs (IHI, n.d.).

Specific Aims and Purpose Statement

The QI project seeks to improve the accuracy of blood loss assessment, addressing unreliability of EBL and its potential to delay timely PPH management at a CAH in Northwestern Montana. The purpose of the project is to implement a standardized QBL protocol during all cesarean deliveries. By implementing a standardized QBL protocol, the project aims to improve clinical decision-making and maternal outcomes in an underserved rural setting.

Three sequential SMARTIE goals guide the QI initiative. The short-term SMARTIE goal (Table 1) is to ensure that 100% of OR staff complete QBL education by February 1, 2026. Training will be conducted during the OR's monthly staff meeting in January 2026, focusing on documentation, role-specific responsibilities, and the application of QBL tools through a combination of video-based education and hands-on practice. The mid-term SMARTIE goal

(Table 2) is to achieve 50% QBL documentation in the EHR for all cesarean deliveries performed at the facility during the project timeline. Finally, long-term SMARTIE goals (Table 3) are beyond the immediate scope of the project, with a future goal to attain 100% QBL documentation in the EHR for all cesarean deliveries performed at the facility. The identified goals are feasible and measurable, given the site's low cesarean delivery volume (0–2 per month), and are supported by targeted training, workflow integration, and resource allocation. While QBL is not a new concept, its application in cesarean care represents a practice change in a rural CAH, offering the potential for more accurate blood loss assessment, earlier identification, and timely interventions. The project is grounded in evidence-based practice and guided by the IHI Model for Improvement. Iterative PDSA cycles will be used to test and refine changes. Implementation will be supported by QBL worksheets, standardized EHR templates, audit dashboards, and feedback mechanisms to ensure sustainability and continuous improvement.

Collaboration among key stakeholders is essential to the successful integration of QBL into routine practice. The project will require several resources to support implementation, including calibrated drapes and graduated containers for fluid measurement, suction canisters and calibrated scales for weighing blood-soaked materials, QBL worksheets for standardized documentation, a calculator, and EHR templates to streamline data entry. Staff training will be conducted in person and will include hands-on instruction on proper procedures for zeroing the scale. Concurrently, IT support will oversee the implementation of data-tracking systems and the development of dashboards to support ongoing monitoring efforts.

Project outcome evaluation will occur at four- and six-week post-implementation. Key metrics for evaluating the project will include the total number of cesarean deliveries performed, the number of those deliveries with QBL documentation, and the corresponding overall percentages. Although long-term outcomes are beyond the scope of the project, future evaluation may include assessing the protocol's effectiveness in recognizing and reducing PPH rates. By establishing a structured, measurable, and sustainable approach to QBL, the QI initiative supports safer maternal care and advances equity in rural health.

Table 1: Short-term SMARTIE GOAL

Short-term SMARTIE Goal #1: 100% of OR staff will complete QBL education between January 13, 2026, and February 1, 2026. Achieving 100% staff education is feasible given the OR team's small size & low cesarean delivery (CD) volume (0–2 per month). Education is critical to ensure accurate QBL documentation, especially during urgent or emergent CDs where workflow may be disrupted. Staff understanding of QBL tools & roles will improve documentation consistency & patient safety. OR RN to use QBL Worksheet. OR RN will document QBL in EHR. CRNA will monitor suction canister, graduate drapes, & communicate QBL with team.		
Description of strategies to be utilized to accomplish the goal, including any needed resources. • Education Sessions: All OR staff (RNs, CRNAs, surgical techs) will attend a QBL training session led by the DNP student. • Training Materials: QBL Worksheet, EHR documentation guide, scale, graduated containers, calibrated drapes, & suction canister monitoring protocols will be reviewed. • Team Roles Clarified: CRNA will monitor suction canister, graduate drapes, & communicate QBL to the team. OR RN will use the QBL worksheet & document QBL in the EHR. • Required Resources: Scale for weighing blood-soaked items. Calculator for subtracting dry weights & totaling QBL. • DNP student access to site EHR for training & audit purposes. • IT technician support for tracking completion & documentation. • OR staff's participation & teamwork while ensuring QBL is captured accurately.		
Data to be Collected	Method of Collection & Responsible Party	Planned Data Analysis
Completion of QBL education by OR Staff.	Attendance logs maintained by DNP student & OR manager.	Calculate percentage of OR staff who completed training.

Table 2: Mid-term SMARTIE Goal

Mid-term SMARTIE Goal #2: By March 1, 2026, QBL will be performed in at least 50% of cesarean deliveries (CD) at the site, with corresponding QBL documentation recorded in the EHR.		
Description of strategies to be utilized to accomplish the goal, including any needed resources. • 50% of CD is not an unreasonable goal at the site where the average monthly CD occurrence rate is 0-2. • OR RN to use the QBL worksheet & enters data into EHR. • CRNA monitors suction canister, calibrated drapes, & communicates QBL to team. • DNP Student: Oversees training, audits documentation, & compiles final report. • IT specialist: Supports data extraction & reporting from EHR.		
Data to be Collected	Method of Collection & Responsible Party	Planned Data Analysis
Number of CD that have QBL charted in EHR.	The OR RN will total QBL from CD & enter amount into EHR.	Calculate percentage of CDs with QBL documented.
Total number of CDs	Identified via EHR audit by DNP student & IT technician Notes from chart review & staff input.	Used as denominator for compliance rate.
Barriers to documentation	DNP student & IT will access QBL data within the EHR.	Thematic analysis to identify common challenges.
		Final Summary Report: (Post-March 1, 2026). Total number of CDs performed. Number & percentage with QBL documented. Identified barriers & recommendations for improvement.

Table 3: Long-term SMARTIE Goal

Long-term SMARTIE Goal #3: By June 1, 2026, QBL is performed for all cesarean deliveries at the site, with documentation in the EHR for at least 100% of those cases. This goal extends beyond the immediate scope of the project. However, the organization plans to continue the QI project.		
Description of strategies to be utilized to accomplish the goal, including any needed resources. • 100% of CD is not an unreasonable goal the average monthly CD occurrence rate is of 0-2. • OR RN to use the QBL Worksheet & enter data into EHR. • CRNA monitors suction canister & communicates QBL to team. • OR Manager: Oversees training, audits documentation, & compiles quarterly report. • IT specialist: Supports data extraction & reporting from EHR.		
Data to be Collected	Method of Collection & Responsible Party	Planned Data Analysis
Number of CD that have QBL charted in EHR.	The OR RN will total QBL from CD & enter amount into EHR.	Calculate percentage of CDs with QBL documented.
Total number of CDs	Identified via EHR audit by OR Manager & IT technician.	Used as denominator for compliance rate.
Barriers to documentation	Notes from chart review & staff input.	Thematic analysis to identify common challenges.
	The OR Manager & IT technician will access QBL data within the EHR chart.	Quarterly reports.

Methods

Implementation Summary

The QI project will be implemented in the perinatal surgical unit of a rural CAH in Northwestern Montana. The purpose of the project is to implement a standardized QBL protocol during cesarean deliveries. Stakeholders involved in the QI initiative include the DNP student, OB manager, OR manager, OR RNs, surgical technicians, CRNAs, family practice obstetric providers, and IT specialists. The focused patient population includes all individuals undergoing cesarean delivery at the facility during the project period.

The intervention aim is improving maternal safety by assessing and documenting blood loss measurement through QBL. The short-term goal is to educate 100% of OR staff on QBL

procedures, including documentation workflows and role-specific responsibilities. Staff training will be delivered through in-person education and hands-on simulation. The mid-term goal is to ensure QBL is performed for all cesarean deliveries at the site, with documentation in the EHR for at least 50% of those cases. Long-term goals are beyond the immediate scope of the project, with a future goal to attain 100% QBL documentation in the EHR for all cesarean deliveries.

To support implementation, IT specialists will assist with data tracking and the development of audit dashboards. Data will be collected at four- and six-week intervals throughout the project. A mid-term evaluation will take place mid-project, followed by final analysis and assessment of outcomes at the end of the project. Metrics include the number of staff who completed education, the number of cesarean deliveries, and the number of cesarean deliveries with QBL documented during the project dates. The data will be assessed twice during the project timeline to identify and correct any issues.

The education component of the intervention focuses on the perinatal surgical team, primarily OR RNs and CRNAs, by promoting standardized QBL measurement in place of EBL. Along with proper equipment use, completion of the QBL worksheet, collaborative teamwork, and accurate documentation. Implementation strategies include workflow changes, structured education, and enhancements to EHR documentation. The project will be conducted over a 6-week period, with benchmarks for QBL documentation compliance set at 50%. Data will be collected through EHR audits. Iterative PDSA cycles within the IHI Model for Improvement will guide ongoing adjustments and evaluation.

Intervention and Implementation

The protocol aligns with national guidelines from ACOG, AWHONN, and AORN to replace EBL with QBL. A standardized EHR documentation template and structured staff education will support this effort. The implementation involves a multidisciplinary team of stakeholders. Each stakeholder involved in the QI project possesses licensing credentials pertinent to their respective fields and responsibilities, qualifying each for the required task. All necessary QBL tools are already available at the facility, eliminating the need to purchase additional equipment. The only cost consideration is staff time for training, which will be accommodated during regularly scheduled monthly meetings. The QBL protocol and accompanying staff education will be developed and implemented by the project leader, Tabitha Normandeau, a DNP student. The project leader brings over 13 years of experience as a registered nurse, with a clinical background spanning acute inpatient care and obstetric nursing, as well as five years of leadership as an OB unit manager. This expertise supports the effective design and delivery of the initiative. The DNP student will contribute time and effort at no cost to the facility, promoting a resource-conscious and financially sustainable approach. The project leader is currently completing a Doctor of Nursing Practice program with a Family Nurse Practitioner focus, expected to graduate in May 2026. Relevant coursework has directly prepared the student to lead the clinical QI project.

Implementation will follow a structured six-week timeline. Pre-implementation activities include obtaining approval from the Montana State University Institutional Review Board (IRB), securing site approval, engaging stakeholders, defining team roles, and preparing training materials. The site does not have its own facility IRB. During the first two weeks, staff will participate in a one-hour education and hands-on training session. Training objectives are

designed to ensure participants can explain the rationale for transitioning from EBL to QBL, demonstrate accurate measurement and documentation techniques, apply QBL tools and EHR templates in practice, and collaborate effectively to reinforce team-based communication throughout the surgical process. QBL worksheets will be placed in the perinatal surgical unit to support ongoing use of the new protocol. Follow-up question-and-answer sessions will be held during staff meetings to reinforce learning and encourage continuous engagement. Week two will mark the full implementation of the QBL protocol across all cesarean deliveries. Weeks three through four will focus on weekly audits and staff huddles to monitor compliance and gather feedback. In weeks five and six, the team will track documentation benchmark compliance and apply PDSA cycles to refine workflows. Data will be collected through EHR audits. The DNP student and IT specialist will oversee data extraction and reporting. Quarterly reporting will continue post-implementation to support sustainability. In addition, a post-pilot sustainability plan will be developed to ensure long-term integration of QBL practices, including ongoing staff education, leadership engagement, and periodic workflow evaluations.

Strengths of the project include strong leadership support, alignment with national guidelines, and the agility of a small facility, which enables rapid communication and real-time feedback. Anticipated barriers include limited staffing, resistance to change, and measurement and documentation burdens. These will be addressed through workflow integration, cross-training, peer mentoring, streamlined EHR templates, and anonymous feedback mechanisms. Opportunities for improvement include earlier recognition of PPH to enhance maternal outcomes and a scalable model that strengthens surgical team collaboration. Through these strategies, the project aims to foster a culture of continuous improvement and collaborative practice.

Evaluation and Analysis

Evaluation of the QI project will span the six-week implementation period, with formal data collection at weeks four and six, focusing on the total number of cesarean deliveries and those with documented QBL in the EHR. Data will be collected through retrospective chart audits conducted by the DNP student in collaboration with the IT specialists. For each cesarean delivery, the presence or absence of QBL documentation will be recorded.

Descriptive statistics will be used to summarize documentation rates and identify trends over time. These insights will inform iterative PDSA cycles and guide future sustainability efforts. The evaluation will culminate in a final summary report detailing the total number of cesarean deliveries and QBL documentation rates. The report will be shared with key stakeholders to support ongoing quality improvement and inform broader implementation strategies.

Safety and Confidentiality

Patient safety is the cornerstone of the QI initiative. All patients will continue to receive standard care, and no changes will be made to clinical management. QBL assessments will be conducted by RNs in coordination with the surgical and anesthesia teams, ensuring patient safety throughout the perioperative and postpartum periods. The protocol does not introduce additional clinical risk.

Analytics reports will be generated through the EHR system and will include only aggregate data such as delivery counts and QBL documentation rates. Temporary documents used for internal review, such as delivery logs or QBL tracking sheets, will be disposed of in secure shred bins immediately after use, in accordance with hospital policy. All deidentified

project data will be stored on the project leader's password-protected computer in a secure document table. No patient health information (PHI) will be collected as part of the project. IRB approval will be obtained through Montana State University, and site approval will be obtained prior to implementation.

Conclusion

The six-week QI project is designed to enhance maternal safety by implementing a standardized QBL protocol for cesarean deliveries at a rural CAH in Northwestern Montana, located 60 miles from the nearest facility offering advanced obstetric care. To address the limitations of EBL, which is less accurate and can delay recognition and treatment of PPH, the multidisciplinary team will transition to QBL to improve the accuracy of blood loss measurement and documentation for all cesarean deliveries. The intervention integrates calibrated measurement tools, standardized EHR templates, and QBL worksheets, supported by hands-on training for OR staff and iterative PDSA cycles to optimize workflow integration. The primary objective is to achieve 50% compliance with QBL documentation during the project period. To monitor progress and guide improvements, the team will analyze de-identified EHR fields using descriptive statistics. All data management will adhere to Health Insurance Portability and Accountability Act (HIPAA) regulations and role-based access controls, with IRB and site approvals secured prior to implementation.

Grounded in national clinical guidelines and the IHI Model for Improvement, the QI project promotes accurate measurement and documentation of blood loss, timely identification of PPH, and improved maternal outcomes. Furthermore, it offers a replicable framework for other

rural healthcare facilities seeking to enhance surgical team collaboration and patient safety through standardized QBL practices.

CHAPTER THREE

QUANTITATIVE BLOOD LOSS: A QUALITY
IMPROVEMENT PROJECT IN A RURAL PERINATAL
SURGICAL UNIT

Contribution of Authors and Co-Authors

Manuscripts in Chapter 3: 1

Author: Tabitha J. Normandeau, DNP-FNP Candidate

Contributions: Led the evaluation of the clinical problem, completed the literature review, designed the project and intervention, directed implementation, conducted data collection and analysis, and prepared and disseminated the final results.

Co-Author: Dr. Stacy Stellflug, PhD, APRN, FNP-BC

Contributions: Providing academic guidance and advising to the author on evaluating the clinical problem, developing the project framework, and reviewing the proposal, project materials, and final manuscript.

Co-Author: Dr. Melinda Truesdall, DNP, APRN, PMHNP-BC

Contributions: Providing additional scholarly support on project development and offering review and editorial feedback on the manuscript.

Manuscript Information

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- ☒ Prepared for submission to a peer-reviewed journal
- ☐ Officially submitted to a peer-reviewed journal
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- ☐ Published in a peer-reviewed journal

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Abstract

BACKGROUND: Quantitative blood loss (QBL) provides a more accurate assessment of intraoperative blood loss during cesarean delivery than visual estimation. Reliance on visual estimation can delay recognition of postpartum hemorrhage, a leading cause of preventable maternal morbidity and mortality. Accurate and timely measurement is especially critical in low-volume rural hospitals, where limited resources and delayed response time can have significant consequences.

LOCAL PROBLEM: At the project site, a rural critical access hospital (CAH) in northwest Montana, QBL was not performed during cesarean deliveries, representing a deviation from established standards of obstetric care.

METHODS: The project used the Institute for Healthcare Improvement Model for Improvement to implement a standardized QBL protocol, combining workflow changes, staff education, and use of a QBL worksheet to support accurate measurement and documentation during cesarean deliveries. Data were collected through electronic health record audits at scheduled intervals, and iterative Plan-Do-Study-Act cycles guided adjustments.

INTERVENTION: Two interventions were initiated: Surgical staff education on QBL and a QBL worksheet listing the dry weights of all materials.

RESULTS: The project aims were partially achieved, with 82% of staff completing QBL education. Three cesarean deliveries occurred during implementation; all utilized the QBL worksheet, and corresponding QBL values were documented in the electronic health record.

CONCLUSION: CAHs can successfully integrate standardized QBL processes into cesarean workflows with minimal disruption. Sustained use of QBL supports earlier recognition of postpartum hemorrhage, improving the quality of care, maternal outcomes, and patient safety.

Keywords: Quantitative Blood Loss, QBL, cesarean section, postpartum hemorrhage, PPH

Introduction

Clinical Problem

Postpartum hemorrhage (PPH) continues to threaten maternal safety across the United States (U.S.), where it accounts for 11% of maternal deaths, even though evidence shows most of these deaths are preventable (ACOG, 2019). The nation's maternal mortality rate, 17.6 deaths per 100,000 live births, remains the highest among industrialized countries and reflects persistent gaps in early recognition and management of obstetric emergencies (AWHONN, 2021). PPH affects individuals across all risk categories, and 40% of cases occur in women considered low risk, elevating the need for universal, reliable methods for identifying excessive blood loss (ACOG, 2019).

Cesarean delivery intensifies this clinical challenge. Cesarean births represent approximately 30% of U.S. deliveries, and the procedure inherently increases hemorrhage risk due to the surgical blood loss, uterine atony, trauma to pelvic vessels, and complications such as placenta accreta spectrum (Hosseinzadeh et al., 2023; Iddrisu & Khan, 2021; Alonso-Burgo et al., 2024). Average blood loss during cesarean birth is twice that of vaginal delivery, and PPH occurs in 5-10% of cesarean births; rapid detection is essential for preventing severe morbidity (Wlodarczyk et al., 2025; Belfort, 2025). Yet clinicians often rely on visual estimation of blood loss, a method that can over- or underestimate blood loss and delay treatment (Belfort, 2025).

The burden of PPH is even more pronounced in rural regions, where limited staffing, resource constraints, and geographic isolation hinder timely response (Kram et al., 2024). Montana clearly demonstrates these disparities. The state holds the sixth-highest maternal mortality rate in the nation, and its maternal morbidity rate exceeds the national average by 35%

(MOMS, 2020). Pregnant women in rural Montana experience 1.9 times the risk of maternal morbidity, while Indigenous women in Montana face three times the risk compared to white women (Glover, 2022; MOMS, 2020). Inconsistent reporting systems and limited access to specialized obstetric care further obscure the true scope of the problem, especially in rural and Indigenous communities (Rural Health Information Hub, 2023; Montana Department of Public Health and Human Services, 2023).

These national and local trends demonstrate the urgent need for more accurate and standardized approaches to identify hemorrhage during and after cesarean delivery. Implementing quantitative blood loss (QBL) measurement offers a reliable, evidence-based method to improve early detection and strengthen clinical response. Introducing QBL as a standardized practice provides a pathway to reduce preventable PPH-related morbidity and mortality in rural hospitals where the consequences of delayed recognition are most profound.

Review of the Literature

QBL demonstrates greater accuracy and clinical usefulness than estimated blood loss (EBL) during cesarean delivery. Researchers show QBL improves prediction of transfusion needs, reduces unnecessary interventions, and strengthens clinical decision-making (Bell et al., 2020; Blosser et al., 2021; Hire et al., 2020; Seacrist et al., 2019). Khan et al.'s (2025) study shows significant discrepancies between EBL and QBL, underscoring the limitations of EBL in the surgical environment. National guidelines from the American College of Obstetricians and Gynecologists (ACOG) (2019) and the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) (2021) endorse QBL as it provides real-time assessment, reduces both over- and underestimation of blood loss, and supports earlier recognition of PPH. Studies reveal QBL-

based protocols increase timely activation of interventions, shorten response times, and improve clinician confidence (Hire et al., 2020; Joseph et al., 2020; Sleutel et al., 2021; Vogel et al., 2024).

Rural hospitals face distinct challenges when implementing QBL, including limited staffing, inconsistent training, equipment shortages, and low birth volumes (Kozhimannil et al., 2023). These constraints make it difficult to standardize hemorrhage management practices. Facilities lacking administrative support, ongoing education, or system-level commitment often struggle to maintain consistent QBL practices, especially in resource-limited environments (Bhatt et al., 2022; CMQCC, 2022; Dulaney et al., 2022).

Obstetric safety bundles endorsed by ACOG, AWHONN, Alliance for Innovation on Maternal Health (AIM), and California Maternal Quality Care Collaborative (CMQCC) provide a structured framework to support QBL adoption and strengthen hemorrhage recognition and response (AIM, 2022; AWHONN, 2021; CMQCC, 2022). These bundles emphasize standardized protocols, risk assessments, simulation, and multidisciplinary teamwork to promote early detection and coordinated intervention. Their structured, stepwise design is especially valuable for rural hospitals, where limited staffing, fewer specialty resources, and variable experience levels can make consistent hemorrhage management more challenging.

In rural CAHs, clinicians often work in small teams, cover multiple roles, and may have fewer opportunities for high-acuity obstetric exposure. Safety bundles help mitigate these challenges by providing clear expectations, standardized workflows, and ready-to-use tools, reducing reliance on individual clinical judgment. The bundles support sustainability by embedding practices, such as QBL, into routine care rather than relying on sporadic training or

informal processes. Quality improvement studies highlight the importance of leadership engagement, staff education, and consistent reinforcement of standardized practices in sustaining effective QBL implementation, particularly in rural healthcare settings (Dulaney et al., 2022; Hendrixson et al., 2022; Joseph et al., 2020; Ladouceur & Goldort, 2019; Sleutel et al., 2021).

By combining evidence-based safety bundles with targeted QBL implementation, rural hospitals can increase their capacity to recognize hemorrhage early, coordinate team responses, and reduce preventable maternal morbidity, despite the inherent constraints of low-volume, resource-limited environments.

Conceptual Framework

The quality improvement project used the Institute for Healthcare Improvement (IHI) Model for Improvement as the framework for implementing QBL during cesarean deliveries. Three iterative Plan-Do-Study-Act (PDSA) cycles were completed, with each cycle aligned to an individual cesarean birth occurring between January 13 and February 28, 2026. Although the project relied primarily on quantitative data, ongoing discussions between the project leader and stakeholders informed adjustments throughout the process.

During the first PDSA cycle, the team identified two workflow barriers: several new surgical materials had not yet been weighted for the QBL worksheet, and the circulating operating room (OR) nurse could not enter QBL values into the electronic health record (EHR) because OR documentation remained paper-based. To maintain accuracy and continuity, the obstetric nurse entered the QBL values into the EHR, and the team established baseline weights for all new materials and added them to the QBL worksheet. These adjustments ensured subsequent cases began with complete and ready-to-use tools.

In the second PDSA cycle, the team recognized that the lap-sponge bag, designed to hold ten lap sponges, was not listed on the QBL worksheet. Adding this item, along with the dry weight of 10 lap sponges, streamlined the weighing process by allowing staff to weigh the entire bag rather than individual sponges, reducing time and improving consistency.

By the third PDSA cycle, the earlier refinements had strengthened workflow reliability. Staff used the updated worksheet and passed the QBL worksheet to the obstetric nurse during report and the obstetric nurse entered QBL in the EHR.

Findings from the first and second cycles, combined with stakeholder feedback, led to revisions in the QBL worksheet and refinements to staff workflow. These changes informed the third PDSA cycle and strengthened the overall process. The resulting improvements enhanced the accuracy and consistency of QBL measurement and demonstrated how iterative testing can refine practice in a rural CAH, where small teams must adapt quickly and rely on standardized processes to ensure patient safety.

Project Aims

The project aimed to improve the accuracy of blood loss assessment by addressing the unreliability of EBL and the risk of delayed management of PPH at a CAH in northwest Montana. A standardized QBL protocol was implemented during all three cesarean deliveries, and QBL was documented in the EHR.

Methods

Context

The project was implemented at a rural CAH in northwest Montana, a setting that shaped both the need for the intervention and its implementation. Several characteristics of the clinical site were relevant to the project and helped clarify whether these findings may be generalized to other environments.

The CAH operates a small obstetric service with low annual birth volume, which is typical of many rural CAHs. Cesarean deliveries occur infrequently, and staffing patterns vary from day to day, with a mix of full-time, part-time, and per diem nurses supporting the operating room and obstetric units. The staffing structure creates challenges in standardizing practice, ensuring consistent education, and maintaining competency in less frequent procedures. The small team size also enables close communication, rapid workflow adjustments, and strong interdisciplinary relationships, all of which support the implementation of the QBL protocol.

The hospital's physical environment includes a single operating room for cesarean deliveries, where obstetric nurses and surgical staff collaborate closely during procedures. The surgical team has limited access to the EHR system and relies on paper forms for documentation, which contributed to early workflow barriers. The need to revise documentation responsibilities during implementation reflects the adaptability required in small rural settings where resources and technical support are limited.

The organizational culture emphasizes patient safety and continuous quality improvement, aligning with the hospital's participation in statewide maternal health initiatives.

This culture supported the project's educational efforts and facilitated staff engagement with the new QBL process.

Interventions

The interventions for this quality improvement project included implementing a standardized QBL protocol for cesarean deliveries and providing targeted education to OR staff responsible for measuring blood loss. Education was adapted early on to accommodate varying schedules and delivered via a 7-minute instructional video focused on the QBL rationale, measurement steps, and documentation expectations. The project lead remained available throughout the training period to answer questions and provide clarification. Obstetric providers and certified registered nurse anesthetists were exempt from the education component due to their existing competency and prior training in QBL procedures. Education efforts were directed toward OR nurses and surgical technicians. QBL worksheets were placed in the perinatal surgical unit to guide consistent measurement and reporting.

OR nurses were responsible for weighing blood-soaked sponges and drapes and measuring suction canister volumes. Surgical technicians provided the total amount of irrigation fluid used during the procedure so it could be accurately accounted for in the final QBL calculation. Because OR nurses documented on paper forms, workflow adjustments were made to ensure QBL documentation into the EHR. The completed QBL worksheet and calculated values were handed off to the obstetric nurse during the report, who entered the information into the EHR. No additional training was required for obstetric nurses, as QBL is already standard practice during vaginal deliveries. The project lead attended two of the three cesarean deliveries

during implementation to support staff, observe workflow integration, and reinforce correct use of QBL tools.

Measures

Assessment of the interventions focused on both process and outcome measures to evaluate adoption of the QBL protocol. Two primary indicators were used: the proportion of required operating room staff who completed QBL education and the proportion of cesarean deliveries with documented QBL in the EHR. Staff education completion was monitored throughout the implementation window, with a target of 100% participation.

Outcome measurement focused on integrating QBL into clinical practice. EHR audits conducted at four and six weeks assessed the percentage of cesarean deliveries with completed QBL documentation. The project benchmark, QBL documentation in at least 50% of cesarean deliveries, was exceeded, as all three cesarean deliveries during the project period included completed QBL measurements and corresponding EHR entries. Together, these measures demonstrated early adoption of the protocol and successful incorporation of QBL practices into the surgical workflow.

Analysis

Data were reviewed continuously throughout implementation, with formal analyses conducted at the end of weeks four and six. Descriptive statistics were used to evaluate both process and outcome measures, consistent with quality improvement methods emphasizing adoption and compliance trends over time. Percentage calculations were applied to quantify staff education completion and the rate of QBL documentation during cesarean deliveries.

Staff education completion was calculated by dividing the number of staff who completed the QBL training by the total number of required participations. QBL documentation rates were calculated by dividing the number of cesarean deliveries with completed QBL entries in the EHR by the total number of cesarean deliveries during the project period. These values were compared with pre-intervention practices, during which QBL was neither performed nor documented, allowing assessment of change attributable to the intervention.

Because of the small sample size and the project's focus on early adoption rather than hypothesis testing, inferential statistics were not used. Instead, quantification across the two evaluation points provided sufficient insight into protocol uptake, workflow integration, and consistency of QBL documentation. This analytic approach aligned with the project's broader aim of improving the accuracy of blood loss assessment and supporting earlier recognition of PPH through consistent adoption of the QBL protocol.

Results

A total of 11 operating room staff members were required to complete the QBL education. Nine staff members completed the training, resulting in an 82% education completion rate (Table 4).

Table 4. Number of Operating Staff that Completed Quantitative Blood Loss Education

Quantitative Blood Loss Education	Full-Time Operating Room Registered Nurses (RNs) (n=7)		Per Diem RNs (n=2)		Surgical Technicians (n=2)	
	n	%	n	%	n	%
Completed Education						
Yes	7	100	0	0	2	100
No	0	0	2	100	0	0

Three cesarean deliveries occurred during the six-week implementation window. QBL was performed for all three cases, and the corresponding documentation was entered into the EHR, resulting in a 100% documentation rate during the project timeframe (Table 5). These findings reflect early adoption of the standardized QBL protocol and consistent use of the QBL worksheet and EHR documentation workflow during the evaluation period.

Table 5. Number of Cesarean Cases Documented in the Electronic Health Record

	Case 1	Case 2	Case 3
Quantitative Blood Loss (QBL) Measured	Yes	Yes	Yes
QBL Documented in the Electronic Health Record	Yes	Yes	Yes
QBL Amount in milliliters (mL)	1000	433	478

Discussion

The project shows that implementing a standardized QBL protocol in a rural CAH is both feasible and effective, and early indicators reflect strong adoption. The key findings reveal 82% of required operating room staff completed the QBL education, and staff documented QBL for 100% of cesarean deliveries during the six-week implementation period. These results directly

support the project's purpose of improving the accuracy of blood loss assessment and align with the aim of reducing reliance on EBL, which clinicians widely recognize as unreliable and a contributor to delayed recognition of PPH (ACOG, 2019; Blosser et al., 2021; Ruiz et al., 2023).

Limitations

There were several limitations influencing the implementation, interpretation, and applicability of the findings. The small number of cesarean deliveries during the six-week implementation period limits the project's external validity, as the sample size is too small to generalize findings beyond this specific hospital setting or to broader clinical populations.

Next, the rural CAH context further limits applicability, as small team size, close interdisciplinary relationships, and low delivery volume may not reflect conditions in larger or urban facilities. Additionally, the project relied solely on descriptive statistics due to the small sample size, which limits the ability to draw causal inferences.

Barriers

Staffing variability emerged as an earlier barrier. Two per diem nurses were unable to complete the QBL education, reducing overall training completion and potentially affecting consistency in practice. A second barrier involved documentation: the circulating surgery nurse used paper forms and could not enter QBL values into the EHR, necessitating an immediate workflow revision in which the obstetric nurse assumed responsibility for EHR documentation. Through immediate workflow revisions and sustained communication with clinical staff, the project maintained implementation stability and supported the credibility of the resulting data.

Recommendations

Addressing the persistent problem of inaccurate blood loss assessment during cesarean delivery requires a structured, evidence-based approach prioritizing standardization, staff readiness, and system-level support. Based on the findings of this project and the broader literature, several recommendations emerge for organizations seeking to improve recognition and management of PPH.

Health systems should adopt a standardized QBL protocol as a routine component of cesarean delivery care. National guidelines from ACOG (2019), AWHONN (2021), and the Alliance for Innovation on Maternal Health (AIM) Obstetric Hemorrhage Bundle (2022) emphasize QBL as a best practice because it improves accuracy and reduces underestimation or overestimation of EBL. Evidence shows QBL supports early detection of PPH and aids in timely clinical decision-making (Bhatt et al., 2022; Ruiz et al., 2023), making its implementation essential in both high- and low-resource settings.

Successful adoption requires comprehensive staff education. Studies demonstrate education paired with workflow standardization improves compliance and accuracy (Hendrixson et al., 2022; Powell et al., 2020). Organizations should ensure all members of the surgical team receive consistent training and understand their roles in the QBL process. Regular refreshers and competency checks can help sustain long-term adherence.

Integrating QBL into the EHR is another critical step. Clear documentation pathways reduce variability and support reliable data capture. When documentation barriers arise, teams should revise workflows promptly to maintain consistency, as demonstrated in this project. Embedding prompts, flowsheets, or automated calculations within the EHR can further streamline the process and reduce errors.

Interdisciplinary collaboration is essential for sustaining QBL practices. Evidence from the implementation of hemorrhage bundles shows that coordinated teamwork improves outcomes and strengthens response readiness (Joseph et al., 2020; Sleutel et al., 2021). Regular debriefings, simulation drills, and shared accountability across disciplines can reinforce expectations and promote a culture of safety.

Finally, organizations should monitor QBL performance through ongoing quality improvement cycles. Using PDSA cycles, audit-and-feedback mechanisms, and periodic data reviews support continuous refinement and help identify barriers early (Ogrinc et al., 2022). Even in low-volume rural settings, routine monitoring ensures QBL remains integrated into practice and that staff maintain proficiency. Together, these recommendations highlight the importance of standardization, education, workflow integration, and interdisciplinary collaboration in improving the accuracy of blood loss assessment and enhancing maternal safety.

Conclusion

This quality improvement project demonstrated how implementing a standardized QBL protocol during cesarean deliveries in a rural CAH is both feasible and has the potential to positively influence patient outcomes over the long run. By shifting from subjective EBL to QBL, an evidence-based, objective measurement process, the project directly addressed a key contributor to delayed recognition of PPH. The high rates of staff engagement, education completion, and consistent QBL documentation for all cesarean births during the implementation period reflect strong early adoption and highlight the value of clear workflows and interdisciplinary collaboration.

The project's findings support the integration of national guidelines and existing literature to incorporate QBL into cesarean delivery workflows, with the ultimate outcome of improving early detection of PPH (ACOG, 2019; AWHONN, 2021; CMQCC, 2022). The project also highlights the unique challenges rural CAHs face, including limited personnel, high staff turnover, constrained budgets, and geographic isolation, which can delay transfer when complications escalate. Overcoming these barriers requires structured protocols, ongoing training, and systems that reduce variability in clinical practice. Standardized tools like QBL help rural teams compensate for resource limitations by creating predictable, team-based responses, rather than relying on individual experience alone. Partnerships with statewide initiatives, such as the Montana Perinatal Quality Collaborative (MPQC) and the Montana Obstetric and Maternal Support (MOMS) programs, further support sustainability by providing education, funding, and quality-improvement infrastructure tailored to rural needs.

More broadly, the project underscores the importance of implementing structured, evidence-based approaches in rural hospitals, which can reduce preventable complications and strengthen maternal safety. Demonstrating with clear processes, interdisciplinary engagement, and targeted support, rural CAHs can successfully adopt best practices to improve outcomes for the communities they serve.

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CHAPTER FOUR

ADVANCED NURSING ESSENTIALS REFLECTION

Personal Reflection

As I advanced on my journey toward becoming a future Family Nurse Practitioner (FNP), I explored numerous programs and chose the Doctor of Nursing Practice (DNP) program to ensure my education reflected the highest level of clinical preparation, leadership, and professional growth. Conversations with practicing FNPs helped me understand how the DNPs' deeper training, scholarly rigor, and leadership focus align with the provider I aspire to become. Throughout this program, I have strengthened my ability to think critically, lead with purpose, and engage in meaningful quality improvement (QI) work. The AACN Essentials (2021) provide the foundational competencies for advanced nursing practice, and throughout my graduate education, I have demonstrated meaningful growth across all domains and subdomains. My strongest achievements emerge within several domains, including person-centered care, scholarship, quality and safety, interprofessional collaboration, and professionalism. As I near completion of my DNP, I recognize the knowledge, confidence, and clinical insight I have gained. This journey has shaped me into a reflective, competent, and patient-centered clinician, one prepared not only to deliver high-quality care but also to influence practice, mentor others, and contribute to the ongoing advancement of the nursing profession.

Person-Centered Care

A core expectation of nursing practice, as reflected in the AACN Essentials (2021), Domain 2: Person-Centered Care, is the ability to deliver care centered on the person rather than

the disease. This domain emphasizes seeing each individual within the broader web of relationships, culture, environment, and developmental stage. Person-centered care calls for holistic, equitable, respectful, and evidence-based care, while remaining flexible enough to honor what matters most to the patient. Domain 2 requires nurses to integrate scientific knowledge with compassion and individualized understanding through shared decision-making.

My ability to deliver person-centered care strengthened steadily as I progressed through the DNP curriculum. Courses such as Advanced Health Assessment (N601), Diagnostic Reasoning (N607), Advanced Pathophysiology (N602), and Advanced Pharmacology (N603 and N620) challenged me to integrate complex clinical information with an understanding of each patient's values, cultural background, and lived experiences. Vulnerability and Healthcare in Diverse Communities (614) further expanded my awareness of how cultural context and structural inequities influence healthcare behaviors and outcomes. Together, these courses shaped my approach to patient care, reminding me that clinical expertise must always be paired with humility, curiosity, and respect for the individual before me.

I carried these lessons into my family practice clinical rotations, where I had the opportunity to apply person-centered care in real-world settings. One encounter stands out involved a postpartum woman experiencing significant anxiety related to breastfeeding and cultural expectations surrounding motherhood. Through motivational interviewing and culturally sensitive communication, I explored her concerns and helped her identify what mattered most. Together, through shared decision-making, we developed a plan that included lactation support, mental health resources, and family involvement. This experience reinforced the importance of

active listening, validating patient experiences, and engaging patients as true partners in their care.

My quality improvement (QI) project further strengthened my commitment to person-centered care. Implementing quantitative blood loss (QBL) in a rural perinatal surgical unit directly supports maternal safety by improving blood loss measurement accuracy and enabling earlier recognition of postpartum hemorrhage. As I led this project, I emphasized the importance of explaining QBL procedures to patients and families to promote transparency and shared understanding during the birthing process. By advocating for evidence-based maternal safety practices, I worked to ensure every patient, regardless of hospital size or geographic location, receives equitable, high-quality care.

Scholarship for the Nursing Discipline

Domain 4: Scholarship for the Nursing Discipline emphasizes scholarship is not only academic work, but the ongoing process of generating new insights, interpreting evidence, and communicating what we learn to improve care. My development as a nursing scholar grew significantly throughout the DNP program. Courses such as Evidence-Based Practice (N604 and N605), Statistical Applications (N606), Healthcare Informatics (N610), and the Scholarly Project Seminar sequence (N674 and N675) strengthened my ability to critically evaluate research, synthesize evidence, design interventions, and analyze outcomes. These courses pushed me to move beyond simply consuming evidence and to begin generating and applying it to improve clinical practice.

The QBL QI project required me to conduct a comprehensive literature review demonstrating the limitations of estimated blood loss and the advantages of quantitative

measurement. Through this process, I learned to translate research findings into practical recommendations suitable for a rural hospital setting. Drawing on the statistical skills I gained in N606, I developed a data-collection and analysis plan to evaluate outcomes, including measurement accuracy and staff compliance. I also created educational materials to help staff understand the evidence supporting QBL and to build confidence in adopting the new process.

Quality and Safety

Domain 5: Quality and Safety in nursing means using proven and emerging safety principles while delivering care, preventing harm, strengthening system reliability, and ensuring both patients and providers are protected. My understanding of quality and safety deepened through coursework in Design of Healthcare Systems (N608), Program Planning and Evaluation (N611), and Financing and Budgeting in Healthcare Systems (N613). These courses taught me to examine healthcare delivery through a systems-thinking lens, identify care gaps, and design interventions to improve outcomes. These courses also reinforced the importance of aligning clinical practice with organizational structures, workflows, and available resources.

The QBL project emerged from a clear need to improve maternal safety. Prior to implementation, the project site relied on visual estimation of blood loss, a practice known to be inaccurate and associated with delayed recognition of postpartum hemorrhage. Recognizing this risk, I conducted a gap analysis, reviewed national guidelines, and collaborated with clinical and administrative stakeholders to develop a standardized QBL protocol. I met with nursing leaders, led staff training, redesigned workflows, and implemented calibrated tools to ensure accurate measurement. I also developed audit mechanisms to monitor compliance and identify opportunities for improvement.

Leading this project strengthened my ability to drive system-level change. I learned to identify safety risks, develop evidence-based solutions, evaluate outcomes, and advocate for sustainable improvements. The experience reinforced my responsibility as a DNP-prepared nurse to champion initiatives enhancing patient safety and elevate the quality of care across healthcare settings. Quality and safety are dynamic processes requiring continuous evaluation, collaboration, and commitment.

Interprofessional Partnerships

Domain 6: Interprofessional Partnerships center on intentional, value-driven collaboration among diverse professionals, patients, families, and communities to deliver coordinated, team-based person-centered care that strengthens outcomes through shared knowledge, communication, and collective accountability. Interprofessional collaboration became a central component of my development as a clinical leader. Courses such as Advanced Nursing Leadership (N609), Healthcare Informatics (N610), and Ethics, Law & Policy (N612) emphasized the importance of communication, shared accountability, and collaborative decision-making. My clinical rotations further reinforced the value of working closely with physicians, nurses, pharmacists, social workers, and other healthcare professionals to deliver coordinated, high-quality care.

The QBL project required extensive collaboration across disciplines. I partnered with obstetric physicians, anesthesia providers, perinatal and surgical nurses, nurse managers, IT specialists, and hospital administrators to design and implement the new workflow. I facilitated interdisciplinary meetings to review evidence, clarify roles, address concerns, and ensure collective buy-in. Navigating differing perspectives and balancing clinical, operational, and

resource considerations taught me the importance of active listening, flexibility, and shared problem-solving. These partnerships were essential to creating a process that was both evidence-based and feasible for a rural hospital.

Domain 6 reflects my growth as a leader who fosters trust, builds consensus, and promotes shared ownership of patient safety initiatives. The success of the QBL project depended on my ability to communicate clearly, listen intentionally, and create an environment where all team members felt valued and engaged. These experiences will continue to shape my practice as I enter the workforce as an advanced practice registered nurse (APRN).

Professionalism

Domain 9: Professionalism in nursing is the lifelong development of resilient professional identity grounded in integrity, compassion, social justice, and emotional intelligence, shaped through ongoing reflection, mentorship, and diverse experiences that strengthen confidence and the ability to think, act, and advocate as a nurse. My understanding of professionalism evolved through coursework in Ethics, Law & Policy (N612), Advanced Nursing Leadership (N609), and Vulnerability and Healthcare in Diverse Communities (N614). These courses emphasized ethical practice, accountability, advocacy, cultural humility, and lifelong learning. They challenged me to reflect on my values, examine my biases, and cultivate a professional identity grounded in integrity and patient advocacy.

As the leader of the QBL project, I demonstrated professionalism by upholding ethical standards in data collection, maintaining patient privacy, and ensuring transparency throughout the implementation process. I advocated for evidence-based maternal safety practices and maintained accountability for project timelines, outcomes, and stakeholder communication. I

modeled respectful dialogue, openness to feedback, and commitment to continuous improvement. These behaviors align with the expectations of advanced nursing practice and reflect my growth into a practitioner who leads with integrity and purpose.

Domain 9 captures my transition from student to emerging DNP leader. I have developed a professional identity rooted in evidence-based practice, ethical decision-making, and a commitment to improving maternal health outcomes in rural communities. My experiences have strengthened my confidence in leading change initiatives and advocating for patients, families, and populations. I feel prepared to enter practice with the skills, perspective, and resilience needed to contribute meaningfully to the profession.

Through the DNP program, I have grown into a clinician who integrates person-centered care, scholarly inquiry, quality and safety principles, interprofessional collaboration, and professionalism into every aspect of practice. My coursework, clinical experiences, and leadership of the QBL quality improvement project collectively strengthened my ability to think critically, translate evidence into action, lead system-level change, and advocate for equitable, high-quality care. These experiences deepened my understanding of how advanced practice nurses influence outcomes not only through clinical expertise but also through collaboration, ethical leadership, and a commitment to continuous improvement. As I transition into practice as a Family Nurse Practitioner, I carry forward the confidence, skills, and professional identity shaped throughout this journey, prepared to deliver compassionate, evidence-based care and to contribute meaningfully to the advancement of the nursing profession.

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