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Evaluation of Postpartum Hemorrhage Management and Implementation of Medical Protocol in Postpartum Women at EHS Mother and Child Ouargla: A 15-Month Retrospective Study

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Abstract **Original Research Article**

Background: Postpartum hemorrhage (PPH) remains the leading cause of maternal mortality worldwide, representing a major public health concern. In Algeria, despite advances in obstetric care, PPH continues to occur with significant frequency. ***Objective:*** This study aimed to evaluate current management practices of PPH and establish a specific, evidence-based protocol aligned with international recommendations at the Omar Boukhris Mother and Child Specialized Hospital in Ouargla. ***Methods:*** We conducted a descriptive retrospective epidemiological study over 15 months (January 2023 to March 2024). Medical records of all women who experienced PPH following vaginal delivery or cesarean section were reviewed. Data collected included patient demographics, risk factors, clinical management, and maternal outcomes. ***Results:*** Among 9,432 deliveries during the study period, 78 cases of PPH were identified, yielding a prevalence of 0.83%. The mean maternal age was 29.6 years (range: 18-42 years). Multiparity was the predominant risk factor (65%). The most common etiology was cervicovaginal lacerations (29.9%), followed by uterine rupture and retroplacental hematoma (each 6.4%). Blood transfusion was required in 82% of cases, primarily with packed red blood cells. Oxytocin was administered in 76.9% of cases, while sulprostone was not uniformly utilized. Hemostatic hysterectomy was performed in 10 patients (12.8%). Three maternal deaths occurred (4% mortality rate). ***Conclusion:*** PPH exposes women to significant risks including permanent infertility and death. Our findings highlight gaps in standardized care protocols and underscore the critical need for systematic implementation of evidence-based guidelines, multidisciplinary team training, improved documentation practices, and enhanced availability of therapeutic resources to reduce maternal morbidity and mortality.

Keywords: postpartum hemorrhage, obstetric emergency, maternal mortality, hysterectomy, prevention, Algeria, protocol implementation, blood transfusion.

INTRODUCTION

Postpartum hemorrhage represents one of the most severe and unpredictable complications in obstetric practice, affecting millions of women globally each year. The World Health Organization estimates that approximately 70,000 maternal deaths annually are attributable to PPH, with a woman dying every two minutes from pregnancy or childbirth-related causes (WHO, 2022). This preventable and treatable condition disproportionately affects women in low- and middle-income countries, where 85% of PPH-related deaths occur, primarily in sub-Saharan Africa and South Asia.

In Algeria, PPH constitutes the second leading cause of maternal mortality after pre-eclampsia, with an estimated maternal mortality ratio of 227 deaths per 100,000 live births. The condition is responsible for 18-20% of admissions to peripartum intensive care units, placing substantial burden on healthcare systems and families (Nassima et al., 2014).

The clinical definition of PPH has evolved over time. Current guidelines from the International Federation of Gynecology and Obstetrics (FIGO) and WHO define PPH as blood loss exceeding 500 mL within 24 hours following delivery, regardless of mode of birth. Severe PPH is characterized by blood loss exceeding 1,000 mL or any amount of bleeding associated with signs of hemodynamic instability (WHO, 2017).

Despite being largely preventable through active management of the third stage of labor and treatable when identified early, PPH continues to challenge healthcare providers worldwide. The unpredictable nature of severe hemorrhage, coupled with the narrow window for effective intervention, demands well-coordinated, multidisciplinary approaches and strict adherence to evidence-based protocols.

At the Omar Boukhris Mother and Child Specialized Hospital in Ouargla, the healthcare team, comprising both Algerian and Cuban professionals, faces persistent challenges in PPH management. Factors contributing to suboptimal outcomes include limited resources, gaps in systematic protocol implementation, variations in clinical practice, and inadequate documentation. These challenges are compounded by high patient volumes, insufficient staff training in emergency obstetric care, and irregular availability of essential medications and blood products.

The present study was undertaken to comprehensively evaluate current PPH management practices at our institution, identify gaps in care delivery, determine the prevalence and risk factors of PPH, analyze maternal outcomes, and ultimately develop and implement a standardized, evidence-based protocol tailored to our local context. By addressing these critical issues, we aim to contribute to the reduction of preventable maternal mortality and morbidity in our region.

MATERIALS AND METHODS

Study Design and Setting

This descriptive retrospective epidemiological study was conducted at the Omar Boukhris Mother and Child Specialized Hospital (EHS) in Ouargla, Algeria. The facility serves as a referral center for the region, providing comprehensive obstetric and neonatal care with a multidisciplinary team including obstetricians, anesthesiologists, midwives, and nursing staff.

Study Period and Population

The study covered a 15-month period from January 1, 2023, to March 31, 2024. All women who delivered at our facility or were transferred from other institutions with PPH during this period were eligible for inclusion. The study population comprised women who experienced PPH following vaginal delivery, cesarean section, or were referred with active postpartum bleeding.

Inclusion and Exclusion Criteria

Inclusion criteria:

- All women who delivered after 22 weeks of gestation (or with unknown gestational age) at our facility
- Women diagnosed with PPH during the study period
- Women transferred to our facility with active PPH

Exclusion criteria:

- Women with incomplete or unexploitable medical records
- Antepartum hemorrhage cases
- Late PPH (>24 hours to 42 days postpartum)
- Early pregnancy losses or late miscarriages (<26 weeks)
- Women with uncomplicated deliveries without PPH

Data Collection

Following approval from the hospital administration and the department head, we conducted daily reviews of medical archives. A structured data collection form was developed to systematically capture relevant information while maintaining patient confidentiality and adhering to professional secrecy standards.

Data were extracted from multiple sources including:

- Patient medical records
- Delivery room registries
- Operating room logs
- Hospital statistical databases
- Laboratory reports
- Blood bank records

Variables Studied

The data collection instrument comprised four main sections:

1. Demographics and Medical History:

- Maternal age
- Medical conditions (hypertension, diabetes, thyroid disorders, etc.)
- Surgical history (previous cesarean sections, gynecological surgeries)
- Obstetric history (parity, previous instrumental deliveries, abortions, stillbirths, placental abnormalities, uterine curettage, previous PPH)

2. Current Pregnancy Characteristics:

- Number of fetuses
- Gestational age at delivery
- Pregnancy-related complications
- Antenatal care attendance

3. Labor and Delivery:

- Mode of delivery (vaginal or cesarean)
- Type of anesthesia
- Labor characteristics (spontaneous, induced, or augmented)
- Use of uterotonic agents
- Instrumental delivery
- Episiotomy
- Type of placental delivery (spontaneous, manual)

- Cervicovaginal lacerations

4. PPH Management and Outcomes:

- Obstetric interventions (uterine massage, manual placental removal, uterine revision, cervical/vaginal repair)
- Medical resuscitation measures
- Pharmacological treatments (oxytocin, sulprostone, tranexamic acid, antibiotics)
- Blood products transfused
- Surgical interventions (B-Lynch suture, arterial ligation, hysterectomy)
- Use of intrauterine balloon tamponade
- PPH etiology
- Complications
- Maternal outcomes

Diagnostic Criteria

PPH was diagnosed based on clinical assessment and treatment requirements, particularly the need for blood transfusion in previously non-anemic women. Due to the retrospective nature of the study and inconsistent use of graduated collection drapes, precise quantification of blood loss was not available for all cases.

Statistical Analysis

Data were entered and analyzed using IBM SPSS Statistics version 26. Descriptive statistics were calculated, including frequencies, percentages, means, and ranges. Results were presented using tables and figures created with Microsoft Excel and Word 2010-2016.

Ethical Considerations

The study was conducted in accordance with ethical principles for medical research. Patient anonymity was maintained throughout data collection, analysis, and reporting. No personal identifying information was recorded on data collection forms. The study protocol was approved by the hospital administration.

RESULTS

Prevalence of PPH

During the 15-month study period, 9,432 deliveries occurred at our facility, comprising 7,387 vaginal births and 2,045 cesarean sections. Among these, 78 women experienced PPH (66 following vaginal delivery and 12 following cesarean section), yielding an overall prevalence of 0.83%.

Patient Characteristics

Age Distribution:

The mean maternal age was 29.6 years (range: 18-42 years). The age groups 20-29 years and 30-39 years were most represented, accounting for 46.2% and 39.7% of cases, respectively. Women younger than 20 years comprised 14.1% of cases.

Parity: Multiparous women predominated (65%), while primiparous women represented 35% of PPH cases.

Gestational Age:

The majority of deliveries (74%) occurred at term (37-42 weeks), while 18% were preterm (<37 weeks) and 8% were post-term (>42 weeks).

Medical History:

Two-thirds of women (67.9%) had no significant medical history. Among those with medical conditions, hypertension was most common (20.4%), followed by diabetes (6.4%), combined hypertension and diabetes (3.8%), and hypothyroidism (1.3%).

Surgical History:

Previous cesarean section was documented in 15% of cases (12 women), while 85% had no surgical history.

Obstetric History:

Approximately one-third of women (33.2%) had significant obstetric history, including previous abortions (17.9%), instrumental deliveries (5.1%), stillbirths (5.1%), previous PPH (3.8%), and uterine curettage (1.3%). The remaining 66.8% had no relevant obstetric history.

Risk Factors

Episiotomy was the most common risk factor (48.7%), followed by instrumental extraction. No cases of uterine distension from multiple pregnancy or polyhydramnios were identified in this cohort. Notably, 23.1% of women who experienced PPH had no identifiable risk factors.

Delivery Characteristics

Mode of Delivery:

Vaginal delivery accounted for 84.6% of cases, while cesarean section represented 15.4%. All cesarean sections were performed under anesthesia (50% general, 50% spinal), while vaginal deliveries occurred without anesthesia.

Labor Management:

Labor was induced in 87.2% of cases. Uterotonic agents were administered in 87.2% of deliveries, with doses ranging from 5 to over 40 IU of oxytocin. Deliveries were attended by obstetricians in 48.7% of cases and midwives in 51.3%.

Placental Delivery:

Managed active third stage was practiced in 82.1% of cases, while manual placental removal was necessary in 17.1%.

Initial Management

Obstetric Interventions:

- Uterine revision: 44.9%
- Cervicovaginal repair: 29.5%
- Manual placental removal: 11.5%

- Bakri balloon tamponade: 10.3%
- Uterine massage: documented in only 1.3% (likely underreported)
- Digital curettage: 1.3%

Resuscitation Measures:

Documented resuscitation interventions were initiated in only 27% of cases, suggesting either underreporting or delayed recognition of severity.

Transfusion Requirements

Blood transfusion was required in 82% of cases (64 women):

- Packed red blood cells alone: 81%
- Packed red blood cells plus fresh frozen plasma: 14%
- Platelet transfusion: 2%
- Combined products: 3%

Transfusion Adjuncts:

Tranexamic acid was administered in 9% of cases, fibrinogen concentrate in 3%, and recombinant Factor VIIa in only 1.3%. The majority of women (87%) did not receive adjunctive hemostatic agents.

Pharmacological Management

- Antibiotics: 97.4%
- Oxytocin: 76.9%
- Anticoagulation prophylaxis: 59.8%
- Volume expanders: 26%
- Iron supplementation: 15.6%
- Methylergometrine: 2.6%
- Vasopressors (norepinephrine): 6.5%
- Etamsylate: 3.9%
- Ephedrine: 1.3%

Surgical Interventions

Conservative surgery was performed in 4.1% of cases:

- B-Lynch uterine compression suture: 3.8%
- No arterial ligations or uterine artery embolizations were performed

Radical surgery (total hysterectomy) was necessary in 12.8% of cases (10 women), representing a concerning proportion requiring definitive surgical intervention.

Etiologies

- Cervicovaginal lacerations: 29.9% (23 cases)
- Undetermined cause: 42.9% (33 cases)
- Uterine rupture: 6.4% (5 cases)
- Retroplacental hematoma: 6.4% (5 cases)
- Placental insertion abnormalities: 6.4% (4 placentas accreta, 1 placenta previa)
- Episiotomy bleeding: 5.1%
- Uterine atony: 2.6%
- Placental retention: 1.3%

Complications

Most women (73.1%) experienced no documented complications. However, serious complications occurred in 6.5% of cases:

- Hemorrhagic shock: 2.6%
- Disseminated intravascular coagulation: 1.3%
- Combined complications: documented in remaining cases

Maternal Outcomes

The vast majority of women (96%) had favorable outcomes and recovered. However, three maternal deaths occurred during the study period, yielding a case fatality rate of 4% among women with PPH.

DISCUSSION

Prevalence and Comparison

Our observed PPH prevalence of 0.83% is substantially lower than the global estimate of 10.8% reported by WHO and the 2% threshold established by international guidelines. This discrepancy likely reflects significant underdiagnosis rather than genuinely superior outcomes. Several factors contribute to underreporting in our setting:

1. **Lack of standardized blood loss quantification:** The absence of routine use of graduated collection drapes prevents accurate assessment of blood loss, leading to visual estimation, which consistently underestimates actual volumes.
2. **Documentation deficiencies:** Incomplete medical records and the high-pressure environment of busy delivery rooms result in under-documentation of less dramatic hemorrhages.
3. **Variable diagnostic criteria:** The use of transfusion as a proxy for PPH diagnosis may miss cases managed without blood products.

Our prevalence is notably lower than the 4.95% reported from a similar Algerian institution (EHS Laghouat, 2022), supporting the hypothesis of systematic underdiagnosis at our center.

Patient Demographics

The mean age of 29.6 years aligns with findings from other Algerian studies and reflects the typical reproductive age distribution. However, the predominance of women aged 20-39 years (85.9%) experiencing PPH deserves attention, as this represents the period of peak fertility and active reproduction in our region. Early marriage practices and cultural norms favoring larger families may contribute to the high representation of younger women.

The finding that 65% of PPH cases occurred in multiparous women is consistent with established knowledge that multiparity constitutes a major risk factor

for uterine atony. Grand multiparity leads to progressive uterine muscle exhaustion, diminishing contractile capacity and predisposing to atonic hemorrhage. This finding emphasizes the importance of family planning counseling and birth spacing in our population.

Risk Factors and Prevention

The observation that 23.1% of PPH cases occurred in women without identifiable risk factors underscores a critical principle: PPH can affect any woman, regardless of risk profile. This reality mandates universal preventive measures for all deliveries rather than selective application based on risk stratification.

The high episiotomy rate (48.7%) as a leading risk factor warrants critical examination. While episiotomy has selective indications, routine or liberal use increases PPH risk. Our rate substantially exceeds the 33.78% reported from EHS Laghouat and suggests a need for restrictive episiotomy policies aligned with international evidence.

The predominance of term deliveries (74%) suggests that PPH in our setting primarily affects pregnancies reaching appropriate maturation, rather than being driven by prematurity-related complications. This pattern differs from high-income settings where preterm delivery plays a more prominent role in PPH epidemiology.

Obstetric Management Quality

Several concerning patterns emerged regarding obstetric interventions:

Uterine Revision:

Our rate of 44.9% falls dramatically short of the 100% rate at comparable institutions. Systematic uterine revision after delivery is a cornerstone of PPH prevention and early detection, allowing identification of retained products and uterine integrity assessment. The low rate in our setting likely reflects either protocol non-compliance or documentation failures.

Uterine Massage:

Documentation of this fundamental intervention in only 1.3% of cases almost certainly represents severe underreporting rather than actual practice. Uterine massage should be universal in PPH management, and the near-absence in our records points to critical documentation deficiencies that compromise audit and quality improvement efforts.

Cervicovaginal Examination and Repair:

The identification and repair of genital tract lacerations in 29.9% of cases highlights the importance of systematic post-delivery inspection. However, this relatively high rate raises questions about delivery technique quality and whether more judicious use of instrumentation and episiotomy could reduce traumatic injuries.

Balloon Tamponade:

The 10.3% utilization rate of Bakri balloon tamponade demonstrates availability of this life-saving intervention at our institution and represents an important resource. This rate compares favorably with the 10.8% reported from French centers, suggesting appropriate deployment of this conservative technique.

Pharmacological Management Gaps

Critical deficiencies in medical management emerged:

Second-line Uterotonics:

The absence of systematic sulprostone use following oxytocin failure represents a major protocol violation. International guidelines mandate progression to sulprostone or misoprostol within 30 minutes of PPH diagnosis when first-line therapy fails. This gap may reflect medication unavailability, cost constraints, or knowledge deficits.

Tranexamic Acid:

Administration in only 9% of cases falls far below the near-universal use recommended by WHO and supported by the WOMAN trial, which demonstrated significant mortality reduction. At comparable institutions, usage rates reach 36.3%. This represents a missed opportunity for a simple, effective, low-cost intervention.

Fibrinogen Concentrate:

The 3% utilization rate, while modest, represents availability of advanced hemostatic support. However, this remains well below optimal practice at tertiary centers.

Antibiotic Prophylaxis:

The 97.4% rate demonstrates excellent compliance with infection prevention protocols and aligns with international standards.

Transfusion Practices

The 82% transfusion rate appears paradoxically high relative to our low PPH prevalence, suggesting either:

1. Selection bias toward more severe cases in documentation
2. Use of transfusion as a diagnostic criterion
3. Liberal transfusion thresholds
4. Delayed intervention necessitating more aggressive blood product support

The predominant use of packed red blood cells (81%) with limited fresh frozen plasma (14%) and platelets (2%) may indicate:

- Inadequate coagulopathy recognition and management
- Blood product availability constraints
- Knowledge gaps regarding massive transfusion protocols
- Insufficient laboratory monitoring of coagulation parameters

Surgical Management Concerns

The 12.8% hysterectomy rate is alarmingly high, substantially exceeding rates at comparable institutions (1.58% at EHS Laghouat, 1.69% at CHU Kara). This concerning finding suggests:

Delayed Initial Interventions:

Time lost in the critical early management phase, allowing progression to uncontrollable hemorrhage requiring radical surgery.

Limited Conservative Surgery Experience:

The absence of arterial ligation procedures and minimal use of B-Lynch sutures (3.8%) indicates that the surgical team may lack experience with uterine-preserving techniques. When faced with refractory bleeding, surgeons default to hysterectomy rather than attempting conservation.

Unavailable Radiological Intervention:

The complete absence of arterial embolization reflects the lack of interventional radiology services at our facility, eliminating a key option in the therapeutic escalation pathway.

Training Deficiencie:

The gap between international best practices and our surgical management patterns points to urgent training needs in conservative surgical techniques for both Algerian and Cuban team members.

The consequence of this high hysterectomy rate extends beyond immediate physical impact. For young women in a culture valuing fertility, surgical sterilization carries profound psychological, social, and marital implications that may not be captured in clinical outcomes data.

Etiology Pattern

The predominance of cervicovaginal trauma (29.9%) as the leading cause differs from many international series where uterine atony predominates. This pattern suggests:

- Quality concerns regarding delivery technique
- Potentially excessive instrumental intervention
- Need for improved perineal protection methods
- Training opportunities in atraumatic delivery practices

The disturbingly high proportion of undetermined etiology (42.9%) represents a major quality gap. Rigorous evaluation protocols should identify the specific cause in the vast majority of cases. Possible explanations include:

- Incomplete examination protocols
- Documentation deficiencies
- Multiple contributing factors obscuring primary etiology
- Limited diagnostic capacity

Morbidity and Mortality

The 4% case fatality rate among women with documented PPH is concerning, particularly given:

1. **Selection of younger, generally healthier population:** The predominance of women in their 20s and 30s should confer survival advantages
2. **Hospital-based care:** Deliveries occurred in a supervised facility with theoretically available emergency resources
3. **Potentially preventable deaths:** PPH mortality should approach zero in well-resourced settings with appropriate protocols

The three deaths likely resulted from:

- Transfers from other facilities in extremis with delayed referral
- Inadequate early intervention at our institution
- Resource limitations (blood products, medications, surgical expertise)
- Communication and coordination failures between Cuban and Algerian teams with different training backgrounds

Systemic Issues and Barriers

Several cross-cutting problems emerged:

Documentation Quality:

The pervasive documentation deficiencies undermine quality assurance, medico-legal protection, and research efforts. Implementing standardized PPH flowsheets with mandatory completion of key fields could address this gap.

Protocol Adherence:

Variable compliance with established guidelines suggests need for regular training, simulation exercises, and clinical audits with feedback.

Resource Availability:

Intermittent stockouts of essential medications (oxytocin, tranexamic acid, sulprostone) and blood products compromise evidence-based care. Improved supply chain management and emergency stockpiles are essential.

Team Coordination:

The binational composition of our clinical team, while providing valuable expertise diversity, may create communication challenges, particularly regarding emergency protocols. Regular joint training and clear algorithmic decision pathways could enhance coordination.

Knowledge Translation:

Gaps between international evidence and local practice indicate needs for continuing medical education targeting both physicians and midwives.

Recommendations

Based on our findings, we propose comprehensive recommendations across multiple domains:

Preventive Measures

1. **Universal Active Management:** Implement active management of third stage of labor for all deliveries with prophylactic oxytocin (10 IU IM/IV) immediately after delivery
2. **Antenatal Preparation:** Screen all pregnant women for anemia, optimize hemoglobin before delivery, and provide iron supplementation when indicated
3. **Risk Stratification:** Identify high-risk women (previous PPH, coagulopathy, known placental abnormalities) and ensure delivery in appropriately resourced settings
4. **Restrictive Episiotomy:** Adopt selective rather than routine episiotomy policies
5. **Blood Loss Quantification:** Mandate use of graduated collection drapes for all deliveries with immediate recording

Early Recognition and Response

1. **Standardized Assessment:** Implement PPH assessment checklist completed for every delivery within 2 hours postpartum
2. **Rapid Response Teams:** Establish formal PPH response protocols with designated team member roles
3. **Emergency Supplies:** Maintain bedside emergency PPH kits containing essential medications and equipment
4. **Communication Systems:** Establish clear escalation pathways for summoning additional support

Medical Management Protocol

First-line (0-15 minutes):

- Large-bore IV access (2 lines)
- Crystalloid resuscitation
- Uterine massage
- Oxytocin bolus (10 IU IV slow) followed by infusion (40 IU over 4 hours)
- Examination: check placental completeness, uterine cavity, genital tract

Second-line (15-30 minutes if continuing bleeding):

- Sulprostone 500 µg IV (if no contraindications)
- Tranexamic acid 1 g IV
- Bakri balloon placement if available and appropriate
- Notify surgical and anesthesia teams
- Laboratory evaluation: complete blood count, coagulation parameters, type and cross-match

Third-line (30+ minutes or massive hemorrhage):

- Activate massive transfusion protocol
- Maintain fibrinogen >2 g/L
- Consider surgical intervention (B-Lynch, arterial ligation, hysterectomy)
- Transfer to intensive care if available

Surgical Capabilities

1. **Training Programs:** Provide structured training in conservative surgical techniques (B-Lynch, arterial ligation, uterine artery embolization skills)
2. **Simulation Exercises:** Conduct regular emergency drills for PPH scenarios
3. **Surgical Protocols:** Develop clear algorithms indicating when to escalate from medical to surgical management
4. **Equipment Availability:** Ensure immediate access to surgical instruments for hemostatic procedures

Transfusion Services

1. **Blood Bank Coordination:** Maintain emergency blood supply (O-negative, O-positive)
2. **Massive Transfusion Protocols:** Implement ratio-based transfusion (1:1:1 ratio of RBC: FFP: platelets)
3. **Coagulation Monitoring:** Establish point-of-care testing for rapid assessment
4. **Product Availability:** Ensure consistent supply of fibrinogen concentrate, tranexamic acid

Documentation and Quality Assurance

1. **Standardized Forms:** Implement mandatory PPH documentation flowsheets
2. **Hourly Time Recording:** Mark exact times of all interventions for later review
3. **Morbidity Reviews:** Conduct monthly review of all PPH cases with >1000 mL blood loss
4. **Near-Miss Analysis:** Analyze severe cases to identify system improvements
5. **Database Development:** Create electronic PPH registry for ongoing surveillance

Education and Training

1. **Didactic Sessions:** Quarterly updates on PPH management for all delivery room staff
2. **Simulation Training:** Biannual high-fidelity simulations of PPH scenarios
3. **Skills Workshops:** Hands-on training in uterine balloon placement, surgical techniques
4. **Emergency Drills:** Monthly code hemorrhage drills with multidisciplinary team
5. **Joint Team Training:** Specific sessions bringing together Cuban and Algerian staff to align approaches

System-Level Improvements

1. **Supply Chain Management:** Establish systems ensuring continuous availability of essential medications and supplies
2. **Blood Bank Capacity:** Strengthen laboratory capacity for timely cross-matching and product release

3. **Referral Networks:** Formalize relationships with tertiary centers for complex cases
4. **Data Systems:** Develop electronic health records facilitating complete documentation
5. **Quality Indicators:** Track key metrics (PPH rate, transfusion rate, hysterectomy rate, mortality) with quarterly reporting

Research Priorities

1. **Prospective Studies:** Initiate prospective data collection using standardized instruments
2. **Implementation Science:** Evaluate barriers and facilitators to protocol adherence
3. **Economic Analysis:** Assess cost-effectiveness of interventions in resource-limited settings
4. **Long-term Outcomes:** Study fertility outcomes, psychological impacts, quality of life after severe PPH
5. **Regional Collaboration:** Partner with other Algerian institutions for multi-center studies

Strengths and Limitations

Strengths

This study represents the first comprehensive evaluation of PPH management at our institution and provides baseline data essential for quality improvement initiatives. The 15-month study period captures seasonal variations and provides reasonable sample size. The retrospective design allowed efficient data collection without disrupting clinical operations.

Limitations

Several important limitations must be acknowledged:

1. **Retrospective Design:** Reliance on existing documentation prevented standardized prospective data collection and likely resulted in missing or incomplete information
2. **Diagnostic Criteria:** Absence of systematic blood loss quantification using collection drapes means some PPH cases were likely missed while others may have been misclassified
3. **Documentation Quality:** Incomplete medical records for some cases limited data completeness and reliability
4. **Selection Bias:** Documentation may have been more complete for severe cases, potentially skewing prevalence estimates
5. **Single Center:** Findings from one institution may not generalize to other settings
6. **Short Follow-up:** Long-term outcomes including fertility, psychological health, and subsequent pregnancy outcomes were not assessed
7. **Etiology Classification:** The high proportion of undetermined etiology limits interpretation and targeted interventions

CONCLUSION

Postpartum hemorrhage remains a significant threat to maternal health at our institution, despite occurring in a modern hospital setting with available resources. Our findings reveal substantial gaps between international evidence-based guidelines and current practice, particularly regarding:

- Systematic use of quantitative blood loss assessment
- Timely escalation of medical therapy
- Availability and application of conservative surgical techniques
- Documentation quality
- Protocol standardization across multidisciplinary teams

The concerning 12.8% hysterectomy rate and 4% mortality rate among women with PPH underscore the urgency of implementing comprehensive quality improvement initiatives. These preventable outcomes in young, reproductive-age women carry profound implications extending beyond immediate clinical consequences to affect family structure, psychological wellbeing, and social functioning.

However, our study also identified important strengths, including excellent antibiotic prophylaxis compliance, availability of intrauterine balloon tamponade, and access to advanced blood products. These elements provide a foundation upon which to build systematic improvements.

The path forward requires multi-level interventions addressing:

- **Clinical practice:** through evidence-based protocols and regular training
- **Systems:** through reliable supply chains and coordinated services
- **Culture:** through prioritization of documentation and quality assurance
- **Teams:** through enhanced communication between diverse provider groups

Effective PPH management is not solely a clinical challenge but a systems challenge requiring coordinated action across multiple domains. By implementing the recommendations outlined in this study, we can aspire to approach the WHO target of reducing preventable maternal deaths, ensuring that pregnancy and childbirth remain safe passages rather than life-threatening events.

Future research should focus on prospective protocol implementation studies, evaluation of training program effectiveness, economic analyses, and long-term outcome assessment. Regional and national collaboration among Algerian institutions could strengthen evidence generation and facilitate best practice dissemination.

Ultimately, every maternal death from PPH represents not only a personal tragedy but a failure of healthcare systems to provide fundamental protections that modern medicine has rendered possible. Our obligation to women, families, and communities demands nothing less than sustained commitment to evidence-based, systematic approaches to preventing and managing this leading cause of maternal mortality.

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