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An Assessment of Medical Resource Utilization and Hospitalization Cost Associated with a Diagnosis of Anemia in Women with Obstetrical Bleeding in the United States

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Abstract

Objective: Anemia during pregnancy has been associated with adverse maternal and fetal outcomes. Although women with obstetrical bleeding are at increased risk for developing anemia, little is known about the prevalence and burden associated with anemia in hospitalized women with this condition. This study was conducted to estimate the prevalence, demographic characteristics, medical resource utilization, and hospitalization cost associated with a diagnosis of anemia in hospitalized women with obstetrical bleeding in the United States.
Methods: The Healthcare Cost and Utilization Project Nationwide Inpatient Sample (2003) was queried using ICD-9-CM codes to identify all pregnancy-related discharges as well as discharges with diagnosis codes for conditions associated with obstetrical bleeding. Descriptive statistics were used to evaluate demographic characteristics, medical resource utilization components and hospitalization cost for two groups: patients with a diagnosis of anemia and patients without a diagnosis of anemia.
Results: Of the estimated 4,525,714 pregnancy-related discharges in the United States in 2003, more than 250,000 recorded diagnosis codes associated with obstetrical bleeding. Nearly 1 in 5 of these women had an anemia diagnosis. A diagnosis of anemia in hospitalized women with obstetrical bleeding was associated with a 9-fold increase in blood transfusion ($p < 0.0001$), 33% longer average length of stay ($p < 0.0001$), and 50% higher average total cost per hospitalization ($p < 0.0001$).
Conclusions: Anemia and blood transfusion are frequently observed in hospitalized women with obstetrical bleeding. To improve outcomes in these patients and alleviate the adverse impact of anemia on postpartum health status, greater provider awareness of the prevalence and burden of illness associated with a diagnosis of anemia in hospitalized women with obstetrical bleeding is warranted.

Introduction

Iron deficiency and iron deficiency anemia (IDA) continue to disproportionately affect both pregnant and nonpregnant women of childbearing age.[1,2] Based on data collected from the 1999–2000 National Health and Nutrition Examination Survey (NHANES 1999), approximately 7.6 million of the 63.2 million women in the United States between the ages of 20 and 49 are iron deficient, defined as having an abnormal value for at least two iron status measures (serum ferritin, erythrocyte protoporphyrin, or transferrin saturation).[3–5] In addition, an estimated 2.5 million women have IDA, defined as iron deficient with low hemoglobin levels.[3–5]

Among women of childbearing age, risk factors for developing iron deficiency and IDA include black or Hispanic race, income below the poverty level, and education less than grade 12.[4] Pregnant and postpartum women also are highly susceptible to developing iron deficiency and IDA because

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of dietary, physiologic, and clinical factors, such as insufficient dietary iron intake, inadequate iron stores, increased iron requirements, and blood loss during the peripartum period.[1,6,7] Anemia during pregnancy has been associated with adverse maternal and fetal outcomes, including fatigue, reduced immune function, prematurity, and low birth weight.[8–10]

Approximately 10% of U.S. women have postpartum anemia between the time of delivery and 6 months postpartum.[11] Identified clinical risk markers for postpartum anemia include the presence of anemia at 24–29 weeks of gestation, third-trimester anemia, high prepregnancy body mass index (BMI), multiparity, and excessive blood loss during delivery (>500 mL).[4,12–14] Excessive blood loss during the course of delivery is not uncommon. Data from observational studies suggest that in the first 24 hours postpartum, as many as 40% of women who deliver vaginally lose >500 mL of blood, and an estimated 30% of women undergoing a repeat, elective cesarean section lose >1000 mL of blood.[15] Given that current methods of quantifying blood loss during the peripartum period are known to underestimate the severity of blood loss,[16–19] many pregnant and postpartum women at risk for developing postpartum anemia are likely to be inadequately treated prior to hospital discharge.

Typically, pregnant and postpartum women with anemia are managed with either oral iron supplementation or a blood transfusion, depending on the severity of anemia, patient symptoms, and physician preferences.[8,14,20] Anemia may not be adequately treated, however, because of conservative transfusion policies in the inpatient setting and suboptimal treatment compliance with oral iron supplementation[8] in the outpatient setting. A better understanding of the economic and overall health burden of illness associated with anemia and its sequela in hospitalized women with pregnancy-related and postpartum-related bleeding (obstetrical bleeding) is essential for increasing provider and patient awareness, optimizing anemia management, and improving postpartum health status in affected women. For this study, we used *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes to query the largest all-payer, publicly available inpatient database to estimate the prevalence, medical resource use, and hospitalization costs associated with a diagnosis of anemia in hospitalized women with obstetrical bleeding in the United States in the year 2003.

Materials and Methods

Data source

We performed a descriptive analysis of the Agency for Healthcare Research and Quality's (AHRQ) 2003 Healthcare Cost and Utilization Project Nationwide Inpatient Sample (HCUP-NIS), an all-payer national survey of inpatient care in the United States. The HCUP-NIS is a 20% stratified sample (multistaged cluster sample) from a sampling frame that comprises 90% of all U.S. hospital discharges. Included in the sample are U.S. community hospitals, which are defined by the American Hospital Association to be "all nonfederal, short-term, general, and other specialty hospitals, excluding hospital units of institutions."[21] Specialty hospitals that are represented in the survey include obstetrics/gynecology, ear/nose/throat, orthopedic, and pediatric institutions. Facilities excluded from HCUP-NIS include short-term rehabilitation, long-term hospitals, psychiatric hospitals, and alcoholism/chemical dependency treatment facilities. The final sample for HCUP-NIS 2003 included patient-level data for 7,977,728 hospital stays from 994 hospitals.[21]

The NIS is a highly reliable source of data on U.S. hospital admissions and discharges. Reliability is supported by agreement between the NIS, a telephone survey, and the National Health Interview Survey (a national, door-to-door survey). Information included in the NIS is what can be derived from a typical discharge abstract, with safeguards to protect the privacy of individual patients, physicians, and hospitals. These data include 1 primary and up to 14 secondary diagnosis codes; primary and secondary procedures; admission and discharge status; demographic information, such as gender, age, race, and median income for ZIP code; expected payment source; total charges; length of stay; and hospital characteristics.[21] Data on laboratory values and pharmacological therapies administered during the course of an inpatient stay are not available in NIS.

Study subject selection

In our study sample, we included pregnancy-related discharge records with ICD-9-CM diagnosis codes[22] for admissions during pregnancy (630–648) and admissions for delivery (72–75, V27.0, and 650–659) as a primary diagnosis. We then selected cases from the universe of pregnancy-related discharges with at least one diagnosis for a condition associated with pregnancy-related or postpartum-related bleeding, including hemorrhage in early pregnancy (640), hemorrhage from placenta previa (641.1), premature separation of placenta (641.2), antepartum hemorrhage associated with coagulation defect (641.3), rupture of uterus before onset of labor (665.0), rupture of uterus during labor (665.1), inversion of uterus (665.2), laceration of cervix (665.3), high vaginal laceration (665.4), and postpartum hemorrhage (666). Given that HCUP-NIS does not contain laboratory data (e.g., hemoglobin or iron values), we identified patients with anemia using ICD-9-CM codes for IDA (280), acute posthemorrhagic anemia (285.1), and maternal anemia (648.21, 648.22, and 648.24). Type of delivery was determined using ICD-9-CM procedure codes and diagnostic related group (DRG) assignment. Cases with ICD-9-CM procedure code 74 or DRG assignment 370 or 371 were defined as having a cesarean section delivery. Vaginal delivery patients were defined by ICD-9-CM procedure code 72 or 73 or DRG assignment 372–375. Blood transfusion procedures were identified using ICD-9-CM procedure codes 99.00 (perioperative autologous transfusion of whole blood or blood components), 99.03 (other transfusion of whole blood), and 99.04 (transfusion of packed cells).

All women, independent of age, were included in the study. Patients with a diagnosis code for at least one condition associated with pregnancy or postpartum bleeding and an additional secondary diagnosis of anemia were grouped in a cohort labeled "obstetrical bleeding with anemia." A second cohort labeled "obstetrical bleeding without anemia" included patients with a diagnosis for at least one condition associated with pregnancy or postpartum bleeding without an additional diagnosis of anemia.

In order to minimize the impact of outlier patients that are associated with prolonged hospitalization on components of medical resource utilization and hospitalization cost, we excluded all patients reporting an ICD-9-CM diagnosis code of acute renal failure (669.92) or pulmonary collapse (518.0), as well as all patients reporting a procedure code for continuous mechanical ventilation (96.71) or hemodialysis (39.95). Also excluded from the study were 10 discharge records that appeared to contain erroneously recorded ($0) hospital charges for 1 or more inpatient days. After all inclusion and exclusion criteria were applied, 205,281 patients without an anemia diagnosis and 48,967 patients with an anemia diagnosis were included in the descriptive analysis.

This study involved analysis of HCUP-NIS, which is a publicly available dataset and, therefore, was exempt from Institutional Review Board approval per Federal Exemption Category 4 (45 CFR 46.101(b)(4)).

Statistical analyses

Descriptive statistics (mean, median, and range) were calculated for patient demographic characteristics, medical resource utilization components, total charges, and total costs. All analyses accounted for the HCUP-NIS sampling design as described in the relevant HCUP publications.[21,23] Using a standard published algorithm, sample weights were applied to generate national estimates from the observed counts to account for HCUP-NIS cluster sampling methodology for data collection.[21] SAS survey procedure methods (SAS, Cary, NC) were used to perform statistical tests, including *t* tests for continuous variables and chi-square tests for categorical variables, to assess the differences in means and proportions between women with an anemia diagnosis and women without an anemia diagnosis. The *t* test was used for total charge, total cost, age, and length of stay. The chi-square test was used for payer mix, race, median household income level, admission source, discharge status, and blood transfusion procedures. Missing data were excluded from the analysis.

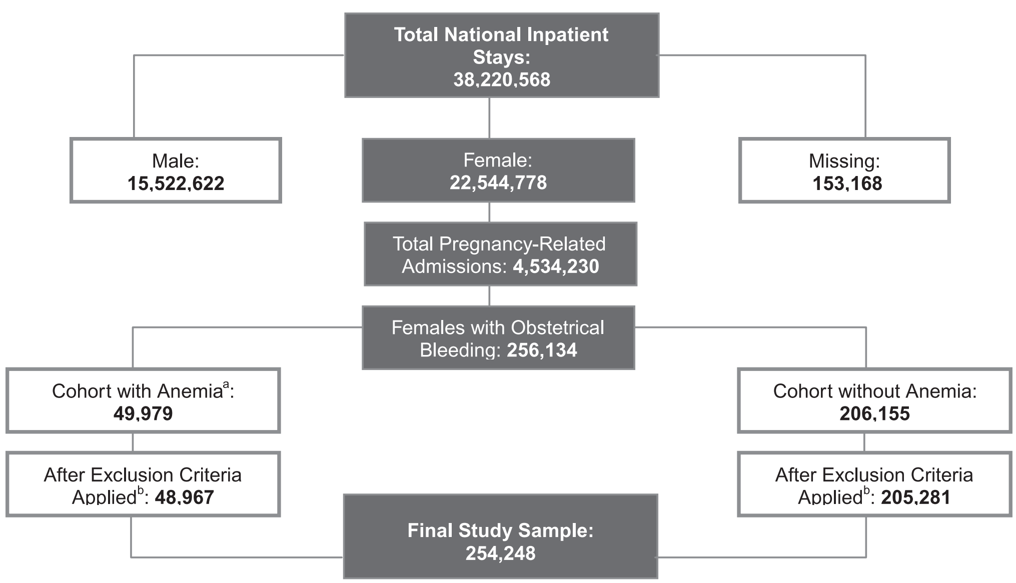
Results

Study sample size and characteristics

We identified >4.5 million discharges with a pregnancy-related or delivery-related ICD-9-CM diagnosis code as a primary diagnosis in the 2003 HCUP-NIS database. For our descriptive analysis, we identified 256,134 patients with a diagnosis associated with obstetrical bleeding (Fig. 1). Nearly 20% (49,979) of these patients also recorded a diagnosis of anemia. As shown in Table 1, the three most common secondary diagnoses in women with an anemia diagnosis were delivery, single liveborn (V27.0); other immediate postpartum hemorrhage, with delivery (666.12); and premature separation of placenta, with delivery (641.21). Based on ICD-9 CM procedure codes and DRG assignment, 37.4% of women with anemia had a cesarean section vs. 21% of women without an anemia diagnosis. A vaginal delivery was recorded for 65.4% and 53% of women without anemia and women with anemia, respectively.

Demographic and socioeconomic characteristics

Table 2 presents demographic and socioeconomic characteristics of the study sample. Hispanic and African American women accounted for 31.6% of patients with anemia



[a]Cases with anemia were identified using ICD-9-CM diagnosis codes for Anemia IDA ([280], acute posthemorrhagic anemia [285.1], and maternal anemia [648.21, 648.22, and 648.24]).
[b]Exclusion criteria included the presence of acute renal failure [669.92], or pulmonary collapse [518.0], as well as all cases reporting a procedure code for continuous mechanical ventilation [96.71] or hemodialysis [39.95].

FIG. 1. Study subject flow diagram.

Table 1. Top Secondary Diagnoses in Patients with Anemia

ICD-9-CM code	*Description*	*Percent*
V27.0	Outcome of delivery, single liveborn	11.3
666.12	Other immediate postpartum hemorrhage, with delivery	7.1
641.21	Premature separation of placenta, with delivery	2.6
648.91	Other current maternal conditions classifiable elsewhere, with delivery	2.5
644.21	Early onset of delivery, delivered, with or without mention of antepartum condition	2.5
659.71	Abnormality in fetal heart rate or rhythm, delivered, with or without mention of antepartum condition	2.0
663.31	Other and unspecified cord entanglement, without mention of compression, complicating labor and delivery, delivered	1.7
664.11	Second-degree perineal laceration, with delivery	1.7
645.11	Postterm pregnancy, delivered, with or without mention of antepartum condition	1.6
654.21	Previous cesarean delivery, delivered, with or without mention of antepartumcondition	1. 5

compared with 26.3% of patients without an anemia diagnosis ($p < 0.0001$). Although private payer coverage was recorded for the majority of women in both cohorts, women with anemia were significantly more likely to be covered by Medicaid than those without an anemia diagnosis (45.4% vs. 37.6%, $p < 0.0001$). The mean age for both the anemia cohort and the cohort without an anemia diagnosis was 27 years.

Medical resource utilization

We used blood transfusion and average length of stay as measures of medical resource utilization. Patients with anemia received a blood transfusion more frequently than patients without an anemia diagnosis (18% vs. 2%, $p < 0.0001$). The average length of stay for patients with anemia was 32.3% longer than for women without a diagnosis of anemia, 4.1 days (95% CI 3.80–4.41) compared with 3.1 days (95% CI 2.97–3.23, $p < 0.0001$).

Economic cost

The average total hospitalization charges for patients with a diagnosis of anemia was 46% higher than for patients without an anemia diagnosis ($13,835 [95% CI $12,242–$15,427]

Table 2. Study Sample Demographic and Socioeconomic Characteristics

Characteristic	*Obstetrical bleeding without anemia (n = 205,281)*	*Obstetrical bleeding with anemia (n = 48,967)*	p *value*
Age			0.8389
Mean (95% CI)	27.16 (26.90–27.40)	27.12 (26.75–27.49)	
Median (range)	27.00 (9.00–52.00)	27.00 (14.00–48.00)	
Age in years, *n* (%)			<0.0001
2–19	24,379 (11.9)	6,303 (12.9)	
20–24	52,804 (25.7)	13,213 (27.0)	
25–29	52,391 (25.5)	11,513 (23.5)	
30–34	48,241 (23.5)	10,768 (22.0)	
35–39	21,944 (10.7)	5,595 (11.4)	
≥40	5,352 (2.6)	1,575 (3.2)	
Unknown	169 (0.1)	0 (0.0)	
Race, *n* (%)			<0.0001
White	75,505 (36.8)	15,934 (32.5)	
Black	19,817 (9.7)	5,739 (11.7)	
Hispanic	34,012 (16.6)	9,762 (19.9)	
Other	14,558 (7.1)	3,553 (7.3)	
Unknown	61,389 (29.9)	13,980 (28.6)	
Median household income, *n* (%)			<0.0001
$1–35,999	50,976 (24.8)	13,465 (27.5)	
$36,000–44,999	51,135 (24.9)	13,691 (28.0)	
$45,000–59,999	53,634 (26.1)	11,634 (23.8)	
≥$60,000	46,600 (22.7)	9,273 (18.9)	

[a]*t* test used for age; chi-square test used for payer mix, age group, race, and median household income.

vs. $9,483 [95% CI $8,768–$10,198], $p < 0.0001$). After multiplying the total hospitalization charges by the hospital-specific cost/charge ratio, the average total cost of hospitalization for women with a diagnosis of anemia was $5,348 (95% CI $4,753–$5,943) vs. $3,573 (95% CI $3,353–$3,793, $p < 0.0001$) for women without an anemia diagnosis.

Discussion

Anemia has been shown to have an adverse affect on the health status of pregnant and postpartum women. According to several recent reports by the Quality Subcommittee of the Committee on Practice for the American Society of Hematology, increasing patient and provider awareness about the burden of anemia is crucial to achieving better health outcomes.[24,25] Data are lacking on the prevalence, medical resource use, and hospitalization costs associated with a diagnosis of anemia in hospitalized women with obstetrical bleeding. We set out to address this data gap by using ICD-9-CM diagnosis and procedure codes to conduct a descriptive analysis of the 2003 HCUP-NIS database.

Our analysis of the nationally representative, all-payer HCUP-NIS database found that nearly 1 in 5 women hospitalized with a condition associated with obstetrical bleeding in 2003 also had an anemia diagnosis. Although we were restricted to using ICD-9-CM diagnosis codes for anemia rather than actual hemoglobin values to identify anemia cases for this analysis, our estimate of the prevalence of anemia in this patient population appears to be conservative based on available data. First, epidemiological data suggest that as many as 37% of all pregnant women have IDA during the third trimester of pregnancy.[2] Second, a recent analysis of California patient discharge data indicates that anemia is underreported in hospitalized obstetrical patients.[26] Third, in our study, 2% of the cohort without a diagnosis of anemia recorded a blood transfusion procedure code; however, given that the threshold for transfusion is expected to be high, one may infer that anemia was not coded for all women who actually had anemia. For example, women who were actively hemorrhaging may have received a blood transfusion before a diagnosis of anemia was made.

The observed prevalence of anemia among Hispanic and African American women and women with lower median household income in our study population is consistent with previously reported data on the development of anemia in women of childbearing age.[4,5,12] In our analysis, patients identified as Hispanic or African American comprised >32% of the anemia cohort. The prevalence of anemia among these women is likely to be much higher than our data suggest, however, given that 29% of the anemia sample had Unknown documented for race. Not all participating HCUP-NIS states supply data on race; therefore, discharges lacking race data are generally classified as Unknown. Although we were unable to directly determine poverty status using HCUP-NIS data, women with anemia were found to have lower median household income and more often were covered by Medicaid than women without an anemia diagnosis.

Identifying pregnant and postpartum women who are appropriate candidates for transfusion therapy is challenging, given that blood loss estimation is imprecise, real-time hematological status may not be accurately reflected by hemoglobin and hematocrit concentrations, and signs and symptoms of hemorrhage may not manifest until blood loss is in excess of 15%.[27] In our study, approximately 5% of women hospitalized with conditions associated with obstetrical bleeding were reported to receive a blood transfusion. Previously reported data indicate that red blood cell transfusions are given in approximately 0.4%–2% of all pregnancies, and in 1.5%–6.8% of cesarean sections.[14,27,28] Available data suggest that blood transfusion is overused in peripartum patients.[27] The inappropriate use of blood transfusions may unnecessarily expose women to harmful risks, including transfusion-related reactions, immunomodulation, and exposure to infectious agents. Safe and effective alternative options, such as intravenous iron, are being developed for treating iron deficiency and IDA in this patient population. Oral iron supplementation is recommended for preventing and treating iron depletion and IDA in all pregnant and postpartum women. However, because of issues with adherence to oral iron therapy—for women with profound iron deficiency and IDA—intravenous iron therapy may be a more appropriate therapeutic intervention than the routine use of blood transfusions.

There are several limitations to our study that warrant discussion. First, our findings are based on the ICD-9-CM diagnosis codes selected for conditions associated with obstetrical bleeding and anemia. Selected diagnosis codes may not capture all relevant cases and, therefore, could underestimate the actual prevalence of this condition and impact other outcome measures of interest, such as race, length of stay, blood transfusion, and average total hospitalization charge. Second, we were limited to the data obtained from HCUP-NIS, which are derived from discharge record abstractions. Detailed and precise information was not available to validate the diagnosis of anemia and other clinical and demographic characteristics of interest. For example, we could not determine the severity of anemia (e.g., hemoglobin level and iron status) or if bleeding occurred upon admission or at the time of transfusion. Third, cross-sectional survey databases, such as the HCUP-NIS survey, do not provide preadmission or posthospital discharge data. Without these additional data, the cause and duration of anemia, as well as posthospitalization discharge medical resource utilization in this patient population, cannot be accurately determined.

Conclusions

Despite the limitations noted, our study demonstrates that anemia is common in hospitalized women with obstetrical bleeding and is associated with frequent blood transfusion, longer average length of stay, and higher hospitalization costs. These findings warrant further investigation to better identify clinical status, hemoglobin values, and iron indices of women hospitalized with obstetrical bleeding who are transfused in the inpatient setting. In addition, anemia is likely to persist in untreated or inadequately treated patients, and studies have shown that anemia in postpartum women may adversely affect cognitive function, mental health, and work capacity.[28–30] Therefore, additional research is also warranted to assess the economic and quality of life burden associated with postpartum anemia in the outpatient setting (following discharge) and to assess the most efficient and reliable method for correcting iron deficiency and anemia in these patients.

Improving provider awareness to more aggressively recognize and treat anemia in hospitalized women with obstetrical bleeding could yield significant benefits at the individual patient level, including fewer blood transfusions and postdischarge utilization of medical services. More importantly, better management of anemia in these patients may lead to fewer adverse maternal and fetal outcomes as well as an improvement in health status and quality of life during pregnancy and the postpartum period.

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