1-1-2016

Effects Of Race, Socioeconomic Factors On Emergency Management Of Threatened And Early Pregnancy Loss

Connie Yu Heng Cheng
Yale University

Effects of Race, Socioeconomic Factors on Emergency Management of Threatened and Early Pregnancy Loss

A Thesis Submitted to the

Yale University School of Medicine

in Partial Fulfillment of the Requirements for the

Degree of Doctor of Medicine

by

Connie Yu Heng Cheng

2016

EFFECTS OF RACE, SOCIOECONOMIC FACTORS ON EMERGENCY MANAGEMENT OF THREATENED AND EARLY PREGNANCY LOSS

Connie Cheng, Steven L. Bernstein, Linda Fan, and Leigh Evans. Department of Emergency Medicine, Yale University, School of Medicine, New Haven, CT.

Our study aims to determine the effects of race, insurance, and hospital characteristics on the management of threatened abortion and early pregnancy loss. In this retrospective cohort study using the National Hospital Ambulatory Medical Care Survey, patient record files from 2002-2010 with diagnoses of threatened abortion, hemorrhage in pregnancy, or incomplete, inevitable, or unspecified spontaneous abortion were examined using logistic regression. Primary outcomes were rates of admission and active management, defined as surgical termination or use of abortifacients misoprostol or Cytotec. Covariates included race/ethnicity, age, insurance, and hospital location, ownership, and metropolitan status. Of 5,882,623 ED visits for threatened abortion and early pregnancy loss, 15% were admitted and 1.3% were actively managed. Compared to white women, black women were 0.83 times as likely to be admitted (95% CI 0.83-0.84), but 4.37 times as likely be actively managed (95% CI 4.25-4.50). Admission was more likely for “Other” women (Asian, Native Hawaiian, Native Alaskan, Native American, mixed race; OR 2.14, 95% CI 2.11-2.17), Medicaid/SCHIP (OR 1.24, 95% CI 1.22-1.25) and Self-pay (OR 1.04, 95% 1.03-1.05) compared to reference groups of white and privately insured women. Historically-marginalized groups, including uninsured, black, and “Other” women, were more likely to be actively managed. Exceptions were Latina (OR 0.84, 95% CI 0.80-0.89) and Medicaid/SCHIP-insured women (OR 0.13, 95% CI 0.12-0.15). Nonwhite women were less likely to be treated for pain, especially Latinas (OR 0.29, 95% CI 0.28-0.29). The etiology of these disparities is complex, but providers may seek to better understand their own preconceptions of patient risk, and to strengthen social support, communication, and shared decision-making.

Acknowledgements

I would like to extend my sincerest appreciation and thanks to my patient and gracious mentors: Dr. Evans, Dr. Bernstein, and Dr. Fan; Dr. Richard Gusberg for connecting me with my research mentors; Dr. Jim Dziura, Mr. Vincent Cheng, and Mr. Oliver Jawitz for assistance with analysis; and the Office of Student Research for short term research funding.

Table of Contents

Introduction

The most common abnormal finding in a woman with a positive pregnancy test and vaginal bleeding is spontaneous abortion [1]. Approximately half of all women who experience vaginal bleeding during pregnancy will miscarry [2], with over twice the risk of spontaneous abortion when bleeding is moderate or heavy [3]. Prior to twenty weeks of gestation, the presence of vaginal bleeding is called threatened abortion. Spontaneous abortion is the non-induced expulsion of products of conception from the uterus during the same gestational period [4]. Spontaneous abortion is categorized as “complete” when all products of conception have been expelled from the uterus and the cervical os is closed [5].

Complete spontaneous abortion requires no further intervention, but several more complicated variants of spontaneous abortion exist as well [6, 7]. Among these variants are “incomplete” spontaneous abortion, where products of conception are passed with retention of some tissue; and “inevitable” spontaneous abortion, which describes vaginal bleeding through an open cervix, without delivery of pregnancy-related tissue [8]. To simplify the terminology of spontaneous abortion, subtypes are sometimes categorized using a combination of ultrasound appearance and clinical presentation. This scheme recognizes the subtypes of “complete”, “incomplete”, and “delayed” spontaneous abortion [7]. Unlike incomplete abortion, delayed abortion includes anembryonic or missed abortions. It occurs before tissue is passed and presents with minimal vaginal bleeding [7].

Diagnostic Work-Up

Diagnostic work-up is important in differentiating spontaneous abortion from other outcomes of pregnancy. Patients with spontaneous abortion often present with lower abdominal pain and vaginal bleeding, which are nonspecific symptoms also found in ectopic pregnancy, molar pregnancy, or simply normal gestation. For a definitive diagnosis, the American Congress of Obstetricians and Gynecologists recommends serum β-hCG testing and ultrasonography to assess for viability of intrauterine gestation [9]. Ultrasonography findings diagnostic of early pregnancy loss include crown-rump length of 7mm without heartbeat, sac diameter of 25mm with no embryo, scan showing gestational sac without yolk sac and absence of embryo with heartbeat 2 weeks later, or scan showing gestational sac with yolk sac and absence of embryo with heartbeat 11 days or later [10]. Other diagnostic steps tests include type and screen and complete blood count (CBC) [6, 9].

Treatment

For spontaneous abortion that is not complete, treatment modalities include expectant management, surgery, or medication [11, 12]. All three methods have been shown to treat spontaneous abortion safely, and rates of serious complication are similarly low. Expectant management requires waiting for spontaneous resolution, a possibly month-long process that can worsen anxiety and grief in patients. This option should be limited to gestations up to eight weeks, and it is not recommended for hemodynamically unstable patients

[9]. In terms of surgical treatment, spontaneous abortion can be managed using sharp curettage or suction curettage, which uses either manual vacuum aspiration (MVA) or electric vacuum aspiration (EVA) [13]. MVA and EVA can also be performed in the outpatient setting, which has been shown to be significantly more time- and cost-effective than performing the same procedure in the operating room [14]. Complications of curettage, however, include uterine perforation, intrauterine adhesions, cervical trauma, hemorrhage, as well as infection in 0.1%–4.7% of patients [15]; patients may also face risks associated with anesthesia. Lastly, medical treatment typically involves use of a synthetic prostaglandin analogue, with or without an antiprogesterone [16, 17]. Misoprostol is a commonly used prostaglandin E1 analogue that ripens the cervix and induces uterine contractions, expelling products of conception and other tissue. The typical regimen includes 800 mg vaginal misoprostol with a repeat dose in three days [9], all of which can be administered in the outpatient setting.

Additionally, pain treatment is often included in the management of spontaneous abortion. Abdominal cramping is common upon presentation as well as after surgical intervention, prompting preemption with NSAID and lidocaine through a paracervical block [18].

Epidemiology

An estimated 15–20% of clinically recognized pregnancies result in spontaneous abortion [19]. This incidence, however, is derived from retrospective

studies, which cannot account for “silent” losses: those unrecognized or mistaken for delayed menses. Thus, the actual rate is thought to range from 25% to as high as 71% [20, 21]. Some groups of women are particularly vulnerable to spontaneous miscarriage and its complications. Women older than 35 years of age, for instance, are more likely to experience spontaneous abortion as well as associated mortality [22, 23]; other reproductive risk factors include chromosomal abnormalities, alcohol use, cigarette smoking, and previous abortion history [6]. Importantly, differences by race have also been identified. Consistent with overall pregnancy-related maternal [24] and fetal [25] mortality, black women may be twice as likely to experience spontaneous abortion as white women [26], even after adjusting for previous miscarriage. Nonwhite women overall may be four times as likely to die from a spontaneous abortion [22].

These demographically-based differences in spontaneous abortion are known to exist, and similar disparities are pervasive throughout other obstetrics outcomes. However, the etiology of these disparities remains unclear. Currently posited theories attribute disparate pregnancy outcomes to social risk factors, such as decreased and delayed prenatal care among marginalized populations [27, 28]. Indeed, black women tend to have lower health insurance coverage [29], less prenatal care, and later initiation of care during pregnancy compared to white women [30-32]. Medicaid-insured or uninsured women are also more likely to delay seeking preventative care [33, 34]. These delays are especially relevant in the context of spontaneous abortion, as the risk of associated maternal death increases with gestational age: between trimesters (Relative Risk = 8 for death in

second vs. first trimester) and even within trimesters (RR = 5.0 at 13-15 weeks, compared to RR=12.9 at 16-20 weeks) [22].

Disparities within Other Obstetrics Outcomes

While the definition of “health disparity” varies across multiple institutions, our research defines disparities using definitions from the World Health Organization (WHO): “differences in health which are not only unnecessary and avoidable but, in addition, are considered unfair and unjust [35]”, as well as from the Agency for Healthcare Research and Quality (AHRQ), where disparities are any statistically significant differences among populations are found, differing from the reference group by at least 10 percent [36].

Demographically-based disparities are well known in terms of healthcare access and care-seeking behaviors. They are also commonly cited as possible perpetuators of racial and socioeconomic disparities in pregnancy outcomes. Separately, demographically-based variations in obstetrics management have also been identified, including racial disparities in C-section (CS) rates [37] and racial, socioeconomic disparities in laparoscopic hysterectomy rates [38]. Fewer studies, however, have investigated demographically-based variations in management as possible effectors of disparate morbidity and mortality. One study of 35,000 women diagnosed with ectopic pregnancy found that nonwhite women were 10-18% less likely to receive laparoscopy as opposed to laparotomy, compared to the reference group [27] – though laparoscopy is the preferred, less invasive surgical approach over laparotomy [39-41]. The same

study also found higher rates of complication, including hemoperitoneum, transfusions, and longer hospitalization stays, among nonwhite and low- or un-insured women [27]. Associated mortality is also higher among African American women, who may experience 6.8 times as many ectopic pregnancy fatalities as white women for every 100,000 live births [42]. Of course, these findings cannot demonstrate a causal relationship between disparate management and outcomes. Moreover, the etiology of demographically-based differences in outcome are likely multifactorial and complex. Nevertheless, differences in management may logically contribute to disparity in outcomes.

To our knowledge, no similar studies have examined demographically-based differences in management within spontaneous abortion. Whether or not they exist, any differences in spontaneous abortion management would indeed result in different outcomes, as varying success rates are demonstrated across treatment modalities. In an assessment of missed or incomplete 1st trimester miscarriages, a 2005 Cochrane meta-analysis of 27 studies (n=3,177) found surgical management to be the most frequently successful method of achieving complete evacuation (compared to medical management, risk difference (RD) = 32.8%, number needed to treat (NNT) = 3, $p<0.001$) [43]. A prospective study found similar results, where treatment failed in more misoprostol-treated women than surgically-managed women with early pregnancy failure [44]. However, providers may consider that surgery can result in complications such as intrauterine adhesions. Medical treatment has also been found to result in complete evacuation more often than expectant management (RD = 49.7%, NNT

= 2, p<0.001) [43]. A randomized controlled trial found that a single dose of 800 mg vaginal misoprostol resulted in complete expulsion for 71% of women within three days. The completion rate increased to 84% after repeat dose [44]. Medical treatment can often be administered at home. Subsequent evaluation using ultrasound or serial β-hCG measurements may be used to confirm complete expulsion [9]. Lastly, expectant management has the lowest success rates of all three methods of intervention [43]. Nearly half of women receiving expectant management eventually request surgery one week post-diagnosis. By two weeks after diagnosis, as many as 70% of patients have been found to request surgery [45]. Fewer complications are seen with expectant and medical treatment compared to surgery, though a longer duration of vaginal bleeding may occur after surgical intervention [11].

No absolute standard treatment algorithm exists for the treatment of spontaneous abortion. Although this allows for a more personalized treatment approach for each patient, it also introduces increased opportunity for biased, subjective, or inconsistency in clinical decision-making. Additionally, demographically-based disparities in management have been identified in other pregnancy outcomes, such as ectopic pregnancy. Taken together, disparities in the management of spontaneous abortion may conceivably exist as well.

Statement of Purpose

Here we identify demographically-based differences in the management of incomplete and delayed spontaneous abortion, threatened abortion, and other

hemorrhage in pregnancy. We hypothesize that nonwhite, uninsured or Medicaid-insured, low-income women are more likely to be 1) discharged to home and 2) managed expectantly, upon presenting to the emergency department.

Materials and Methods

Study Design and Setting:

This study acknowledges the social construct of race and groups patients based on categories assigned by the data source. The categories used by the National Hospital Ambulatory Medical Care Survey (NHAMCS) included non-Hispanic white (hereafter referred to as “white”), black, non-white Hispanic (hereafter referred to as “Latina”), Asian, Native Hawaiian, Native Alaskan, or American Indian (hereafter referred to as “Native American”). For statistical analysis purposes, this study collapses Asian, Native Hawaiian, Native Alaskan, and Native American race/ethnicity, collectively referenced as “Other” women of color.

A retrospective cohort study was performed, using pooled data from the NHAMCS from 2002-2010, inclusive. The NHAMCS is the largest national emergency department (ED) database, administered annually by the Centers for Disease Control and Prevention, National Center for Health Statistics, since 1992. Its findings are collected from a national sample of emergency and outpatient departments in nonfederal, short-stay or general hospitals. This analysis focuses on visits to hospital EDs, for which the probability design

involves 112 geographic primary sampling units, approximately 480 hospitals within these primary sampling units, and patient visits within the emergency service areas. Sample hospitals are randomly assigned to 16 panels that rotate across 13 4-week reporting periods throughout the year. The initial sample frame of hospitals was based on the 1991 SMG hospital database, now maintained by IMS Health.

Data Collection and Processing:

Hospitals are inducted into the NHAMCS by field representatives of the U.S. Census Bureau. Hospital staff or Census Bureau field representatives complete a patient record form for each sampled visit based on information obtained from the medical record. The data collected include information on patient demographics, vital signs, up to three diagnosis codes as listed by the provider, diagnostic tests ordered, procedures provided, providers consulted, up to eight medications prescribed, and disposition, including hospital discharge information if admitted (since 2005). Between 2002-2010, approximately 91.2% of sampled hospitals participated in the survey, and about 91.1% of sampled EDs provided complete information on their sample visits for a total unweighted response rate of 85.3%.

The NHAMCS is approved annually by the Ethics Review Board of NCHS with waivers of requirements to obtain informed consent of patients and patient authorization for release of patient medical record data by health care providers. Data processing, including medical coding of reason for visit, cause of injury, diagnosis, and medications are performed by SRA International, Inc., Durham,

NC. As part of the quality assurance procedure, a 10% quality control sample of patient record files is independently keyed and coded. Error rates typically range between 0.3% and 0.9% for various survey items.

This study analyzes 9 years of data from 2002-2010, which includes 323,135 patient record files provided by EDs across the United States. Initial analysis of demographic factors included all patient record files (PRFs) meeting the following criteria: (1) any-listed provider or recoded provider diagnosis, or (2) principal hospital discharge diagnosis with International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) code indicating threatened abortion (ICD-9-CM 640, 640.03), hemorrhage in pregnancy (640.8, 640.83, 640.9, 640.93), as well as incomplete or unspecified spontaneous abortion with or without complications (634, 634.01, 634.1, 634.11, 634.2, 634.21, 634.3, 634.31, 634.4, 634.41, 634.5, 634.51, 634.6, 634.61, 634.7, 634.71, 634.8, 634.81, 634.9, 634.91, 637.01). When ICD-9 codes indicated complete spontaneous abortion or delivered pregnancy, records were excluded. After exclusion of complete spontaneous abortion, note that the remaining variants of spontaneous abortion are referenced as “non-complete” spontaneous abortion for simplicity. Duplicate records were also excluded to identify unique admissions. Also excluded were records with no disposition listed, with a disposition listed as “unknown”, those who left against medical advice, or those who left before/after examination.

Records meeting these inclusion criteria were weighted by patient weight (PATWT), as provided by the NHAMCS. They were then assessed for baseline

demographic characteristics, diagnostic procedures performed, pain management, hospital discharge diagnosis, disposition, and method of management. Select diagnostic procedures were chosen for our study based on ACOG standard-of-care recommendations, as well as availability of documentation in the NHAMCS intake. To determine whether pain was treated, records were included if any of the 8 listed medications was classified as (1) anesthetic or adjunct to anesthetic (National Directory Drug Class 100, 117, 118, 119, 121, 1275), (2) analgesic (1275, 1720, 1721, 1722), (3) NSAID (1727), or (4) relief of pain (1700). Note that prior to 2006, the FDA's National Drug Code Directory was used for therapeutic classification. Therefore, from 2002-2006, therapeutic classifications reflect the primary drug class as described by the National Drug Code Directory. Since 2006, Multum's Lexicon Drug Database [http://www.multum.com] has been used to classify medications. Thus, from 2006-2010, therapeutic classifications reflect Category 1 of Multum's 3-level nested category system.

Primary outcomes were disposition and management. A disposition of "admission" was designated if the patient record indicated any of the following dispositions: Transfer to any hospital, Admission to any hospital, or Admission to observation unit. A disposition of "discharge" was designated if the patient record listed any of the following dispositions: No follow-up planned; Return if needed; or Returned/referred to physician, nursing home, social services, or any other program except a hospital. In terms of management approach, "actively treated" patients included those receiving either medical management (receipt of

misoprostol or Cytotec) or surgery (admission to the OR). For all other patients, expectant management was assumed – regardless of admission or discharge. Note that “admission to the OR” was documentable as a disposition option only since 2005. Secondary outcomes included use of diagnostic tests and procedures (pregnancy test, ultrasonography, and complete blood count), as well as use of consulting physician, assumed to be an obstetrician / gynecologist.

An initial analysis was conducted describing baseline characteristics of the study population and hospital characteristics. Subsequently, we used logistic regression analysis to determine the effects of clinically relevant covariates on primary and secondary outcomes. The weighted regression model incorporated the following covariates: age, race/ethnicity, insurance provider, hospital geographic region, hospital ownership, hospital metropolitan status, and an interaction term consisting of the product of insurance by race. Simultaneous data entry, or the enter method, was used in this regression approach. Statistical analysis was performed using commercially available software (SPSS version 22.0, IBM Corporation, Armonk, NY). Exemption was granted by the Human Investigations Committee at Yale New Haven Hospital.

All data, which is publicly available, was downloaded and analyzed by Connie Cheng. Dr. Dziura, Mr. Cheng, and Mr. Jawitz were consulted for guidance around statistical methods. Dr. Evans, Dr. Bernstein, and Dr. Fan contributed their thoughts to the interpretation of results. Thesis was written by Connie Cheng.

Results

Using the NHAMCS database, 2,060 visits representing threatened abortions and early pregnancy loss (excluding completed spontaneous abortions) in the United States were identified during 9 years (2002–2010). Samples were weighted by patient weight, reflecting 6,017,788 total cases. Exclusion criteria were applied, resulting in a final cohort size of 5,882,623 threatened, incomplete, delayed spontaneous abortion and other hemorrhage in pregnancy. Table 1 describes the ICD-9 codes used to identify these cases.

Table 1. ICD-9 Diagnoses designated as threatened abortion and early pregnancy loss from NHAMCS record files

634	Spontaneous Abortion Unspecified Complicated By Genital Tract And Pelvic Infection
634.01	Spontaneous Abortion Incomplete Complicated By Genital Tract And Pelvic Infection
634.1	Spontaneous Abortion Unspecified Complicated By Delayed Or Excessive Hemorrhage
634.11	Spontaneous Abortion Incomplete Complicated By Delayed Or Excessive Hemorrhage
634.2	Spontaneous Abortion Unspecified Complicated By Damage To Pelvic Organs Or Tissues
634.21	Spontaneous Abortion Incomplete Complicated By Damage To Pelvic Organs Or Tissues

634.3	Spontaneous Abortion Unspecified Complicated By Renal Failure
634.31	Spontaneous Abortion Incomplete Complicated By Renal Failure
634.4	Spontaneous Abortion Unspecified Complicated By Metabolic Disorder
634.41	Spontaneous Abortion Incomplete Complicated By Metabolic Disorder
634.5	Spontaneous Abortion Unspecified Complicated By Shock
634.51	Spontaneous Abortion Incomplete Complicated By Shock
634.6	Spontaneous Abortion Unspecified Complicated By Embolism
634.61	Spontaneous Abortion Incomplete Complicated By Embolism
634.7	Spontaneous Abortion Unspecified With Other Specified Complications
634.71	Spontaneous Abortion Incomplete With Other Specified Complications
634.8	Spontaneous Abortion Unspecified With Unspecified Complication
634.81	Spontaneous Abortion Incomplete With Unspecified Complication
634.9	Spontaneous Abortion Unspecified Without Complication
634.91	Spontaneous Abortion Incomplete Without Complication

637.01	Unspecified Abortion Incomplete Complicated By Genital Tract And Pelvic Infection
640	Threatened Abortion Unspecified As To Episode Of Care
640.03	Threatened Abortion Antepartum
640.8	Other Specified Hemorrhage In Early Pregnancy Unspecified As To Episode Of Care
640.83	Other Specified Hemorrhage In Early Pregnancy Antepartum
640.9	Unspecified Hemorrhage In Early Pregnancy Unspecified As To Episode Of Care
640.93	Unspecified Hemorrhage In Early Pregnancy Antepartum

Baseline characteristics of the population, their dispositions, management, and diagnostic procedures are given in Table 2. Most patients were Medicaid/SCHIP-insured white women aged 25-44 years (mean age 26.5 years), receiving treatment at a metropolitan, voluntary non-profit hospital center. Women presenting with threatened and non-completed spontaneous abortion were usually discharged home (5,274,533 patients, or 87.6% of cohort), while about 608,090 threatened abortions (10.1%) resulted in hospital admission. In terms of management, expectant management was the preferred approach, occurring in 5,941,511 or 98.7% of patients. Medical or surgical treatment occurred in only 1.3% cases, or 76,277 threatened and spontaneous abortions. Diagnostic procedures included use of ultrasound, pregnancy test, complete blood count (CBC), and use of consulting physician, which were assumed to be

OB/GYNs. The most common diagnostic test was CBC, ordered for 3,944,990 women (65.6%) with threatened and non-complete spontaneous abortions. In contrast, consulting physicians were utilized in only 492,434 cases of threatened abortion, or 8.2% of patients. Lastly, 1,208,595 women with threatened and non-complete spontaneous abortions (22.3%) received treatment for pain.

Table 2. Baseline characteristics and diagnostic procedures in a cohort of 5,882,623 threatened abortions and early pregnancy losses[A] in the US

Age (years)	
Mean	26.5
Race / Ethnicity	**# threatened abortions[A] (%)**
White	2,493,636 (42.4%)
Black or African American	1,616,113 (27.5%)
Latina	1,015,221 (17.3%)
Other[B]	334,608 (5.7%)
Blank / Missing	423,045 (7.2%)
Insurance Type	
Private	2,020,767 (34.4%)
Medicare	64,408 (1.1%)
Medicaid / SCHIP	2,013,142 (34.2%)
No charge / Charity	74461 (1.3%)
Self-Pay	1,270,256 (21.6%)
Other	140,356 (2.4%)
Blank / Missing	299,233 (5.1%)

Table 2. Baseline characteristics and diagnostic procedures in a cohort of 5,882,623 threatened abortions and early pregnancy losses in the US[A]

Hospital geographic region	
Northeast	922,925 (15.7%)
Midwest	1,257,719 (21.4%)
South	2,439,501 (41.5%)
West	1,262,478 (21.5%)
Metropolitan status	
MSA (Metropolitan Statistical Area)	649,858 (11.0%)
Non-MSA (includes micropolitan statistical areas)	5,232,765 (89.0%)
Hospital ownership	
Voluntary non-profit	4,079,210 (69.3%)
Government, non-Federal	938,616 (16.0%)
Proprietary	864,797 (14.7%)
Diagnostic Procedures	
Ultrasound	2,910,112 (49.5%)
Pregnancy test	2,568,088 (43.7%)
CBC	3,868,366 (65.8%)
OB/GYN consult called	492,434 (8.4%)
Pain management	
Received treatment for pain	1185,824 (20.2%)

Table 2. Baseline characteristics and diagnostic procedures in a cohort of 5,882,623 threatened abortions and early pregnancy losses in the US[A]

Disposition	
Admit to hospital	**608,090 (10.3%)**
Discharge to home	5,274,533 (89.7%)
Blank / Missing	19,904 (0.0%)
Management	
Treated (surgical or medical)	74,775 (1.3%)
Expectant	5,807,848 (98.7%)

N= 5,882,623

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

The effect of age, race/ethnicity, and socioeconomic characteristics on dispositions and management of threatened and non-complete spontaneous abortions as estimated by logistic regression are described in Table 3.

Table 3. Disposition of threatened abortions and early pregnancy losses in the US[A,B]

Variable	Disposition						
	Admit		Discharge		Adj OR	(95% CI)	P-val
	n	%	n	%			
Age (years)							
Mean	27.0		26.5		1.03	(1.03-1.03)	<0.001
Race / Ethnicity							
White	257,873	10%	2,235,763	90%	1.00	Ref	
Black	209,870	13%	1,406,243	87%	0.83	(0.83-0.84)	<0.001
Latina	69,823	7%	945,398	93%	0.00	(0.00-6.25e68)	0.83
Other[C]	51,913	16%	282,695	84%	2.14	(2.11-2.17)	<0.001
Blank	18,611		404,434				
Insurance Type							
Private	207,284	10%	1,813,483	90%	1.00	Ref	
Medicare	2,537	4%	61,871	96%	0.00	(0.00-5.06e168)	0.93
Medicaid / SCHIP	279,652	14%	1,733,490	86%	1.23	(1.22-1.24)	<0.001
No charge / Charity	1,023	1%	73,438	99%	0.00	(0.00-1.41e217)	0.94
Self-Pay	92,205	7%	1,178,051	93%	1.04	(1.03-1.05)	<0.001
Other	11,883	8%	128,473	92%	0.00	(0.00-3.37e182)	0.93
Missing data	13,506		285,727	95%			
Hospital region							
Northeast	164,960	18%	757,965	82%	1.00	Ref	
Midwest	159,244	13%	1,098,475	87%	0.66	(0.66-0.67)	<0.001
South	197,058	8%	2,242,443	92%	0.44	(0.43-0.44)	<0.001
West	86,828	7%	1,175,650	93%	0.35	(0.35-0.35)	<0.001

Table 3. Disposition of threatened abortions and early pregnancy losses in the US[A,B]

Variable	Disposition						
	Admit		Discharge		Adj OR	(95% CI)	P-val
	n	%	n	%			
Metropolitan status							
Non-MSA	47,906	7%	601,952	93%	1.00	Ref	
MSA	560,184	11%	4,672,581	89%	1.61	(1.59-1.62)	<0.001
Hospital ownership							
Voluntary	428,407	11%	3,650,803	89%	1.00	Ref	
Government	124,430	13%	814,186	87%	1.30	(1.29-1.31)	<0.001
Proprietary	55,253	6%	809,544	94%	0.75	(0.75-0.76)	<0.001

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Unless otherwise noted, values are given as a weighted number and % of threatened abortions within each demographic segment, adjusted for demographic factors

[C]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

In assessing the effect of patient age on disposition, the odds of admission increased incrementally by 3% for every 1-year increase in age (OR 1.03, 95% CI 1.029-1.030). When evaluating the effect of race/ethnicity on disposition, black women with threatened and spontaneous abortion were less likely to be admitted compared to white women (0.83, 95% CI 0.83-0.84). Other women of color, however, were nearly twice as likely to be admitted (OR 2.14, 95% CI 2.11-2.17), though note that Latina ethnicity was not a significant variable affecting disposition.

Likewise, women with Medicaid / SCHIP (OR 1.23, 95% CI 1.22-1.24) were also more likely to be admitted compared to privately-insured women. Hospitals in every geographical region, including the Midwest (OR 0.66, 95% CI 0.66-0.67), South (OR 0.44, 95% CI 0.43-0.44), and West (OR 0.35, 95% CI 0.647-0.353), were less likely to admit for threatened and spontaneous abortion compared to hospitals in the Northeast. Compared with hospitals in non-metropolitan areas, metropolitan hospitals were more likely to admit women with threatened abortion (OR 1.61, 95% CI 1.59-1.62). Lastly, government-owned hospitals were more likely to admit patients (OR 1.30, 95% CI 1.29-1.31), while proprietary hospitals were less likely to admit (OR 0.75, 95% CI 0.75-0.76) compared to voluntary, non-profit hospitals.

The other major outcome assessed was the method of managing threatened and non-complete spontaneous abortion, as affected by socioeconomic factors (Table 4).

Table 4. Management of all threatened abortions and early pregnancy losses in the US[A,B]

Variable	Management						
	Expectant		Active		Adj OR	(95% CI)	P-val
	n	%	n	%			
Age (years)							
Mean	26.5		27.4		0.99	(0.99-0.99)	<0.001
Race / Ethnicity							
White	2,531,160	99%	19,845	1%	1.00	Ref	
Black	1,642,011	98%	32,738	2%	4.37	(4.25-4.50)	<0.001
Latina	1,022,590	99%	5,367	1%	0.84	(0.80-0.89)	<0.001
Other[C]	330,598	97%	10,434	3%	8.32	(8.06-8.59)	<0.001
Blank	415,152		7,893				
Insurance Type							
Private	1,995,112	98%	42,133	2%	1.00	Ref	
Medicare	62,087	96%	2,321	4%	0.00	(0.00-1.31e151)	0.93
Medicaid / SCHIP	2,068,567	100%	8,537	0%	0.11	(0.11-0.13)	<0.001
No charge / Charity	66,759	90%	7,702	10%	0.00	(0.00-9.63e217)	0.95
Self-Pay	1,298,069	99%	15,555	1%	3.73	(3.62-3.85)	<0.001
Other	142,314	100%	-	0%	0.00	(0.00-6.29e172)	0.94
Missing data	308,603		29				

Table 4. Management of all threatened abortions and early pregnancy loss in the US[A,B]

Variable	Management						
	Expectant		Active		Adj OR	(95% CI)	P-val
	n	%	n	%			
Hospital region							
Northeast	899,804	96%	39,467	4%	1.00	Ref	
Midwest	1,288,168	100%	-	0%	0.00	(0.00e6.22e19)	0.58
South	2,463,534	99%	29,948	1%	0.26	(0.25-0.26)	<0.001
West	1,290,005	99%	6,862	1%	0.13	(0.12-0.13)	<0.001
Metropolitan status							
Non-MSA	657,444	100%	-	0%	1.00	Ref	
MSA	5,284,067	99%	76,277	1%	1.61	(1.59-1.62)	0.71
Hospital ownership							
Voluntary	4,117,092	99%	57,303	1%	1.00	Ref	
Government	955,455	99%	6,057	1%	0.56	(0.55-0.58)	<0.001
Proprietary	868,964	99%	12,917	1%	1.64	(1.60-1.68)	<0.001

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Unless otherwise noted, values are given as a weighted number and % of threatened abortions within each demographic segment

[C]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

Regardless of admission or discharge, the chances of active management (receiving medication or surgery instead of expectant management) decreased 1% for every year that age increased (OR 0.99, 95% CI 0.992-0.994). Nonwhite women were much more likely to undergo active management, including black patients (OR 4.37, 95% CI 4.25-4.50) and other women of color (OR 8.32, 95% CI 8.06-8.59). Interestingly, Latina women were less likely to receive active management (OR 0.84, 95% CI 0.80-0.89). Insurance status was a significant predictor: women paying out of pocket were more likely to undergo active management (OR 3.73, 95% CI 3.62-3.85). However, Medicaid/SCHIP patients were much less likely to receive active management (OR 0.11, 95% CI 0.11-0.13). Hospital geographic location also affected the odds of active management, as hospitals located outside of the Northeast were less likely to manage threatened and non-complete spontaneous abortions actively (South, OR 0.26, 95% CI 0.25-0.26; West, OR 0.13, 95% CI 0.12-0.13). Government hospitals were 0.56 times as likely to actively manage threatened and spontaneous abortions (95% CI 0.55-0.58) compared to voluntary, for-profit centers. However, proprietary hospitals were 1.56 times as likely to manage patients actively (95% CI 1.60-1.68).

Besides assessing the effects of socioeconomic variables and hospital characteristics on disposition and treatment of threatened and non-complete spontaneous abortion, the present study also evaluated the effect of these variables on diagnostic procedures (Table 5a-d). These included receipt of ultrasound, pregnancy test, complete blood count, and evaluation by consulting

physician, which was assumed to be an OB/GYN. Within each individual diagnostic test, significant differences indeed existed with respect to patient race and insurance, and hospital geographic region, metropolitan status, and ownership. However, no consistent demographic trends were found when evaluated across all four diagnostic procedures.

Table 5a. Ultrasound use in the emergency management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
Age (years)					
Mean	26.6		1.01	(1.01-1.01)	<0.001
Race / Ethnicity					
White	1,256,139	49.2%	1.00	Ref	
Black	801,601	47.9%	1.66	(1.65-1.67)	<0.001
Latina	558,476	54.3%	1.49	(1.48-1.51)	<0.001
Other[C]	142,301	41.7%	0.47	(0.46-0.47)	<0.001
Blank / Missing	191,293				
Insurance Type					
Private	1,073,261	52.7%	1.00	Ref	
Medicare	48,820	75.8%	6.55	(6.35-6.76)	<0.001
Medicaid / SCHIP	946,537	45.6%	0.77	(0.76-0.77)	<0.001

Table 5a. Ultrasound use in the emergency management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
No charge / Charity	50,676	68.1%	1.24	(1.20-1.27)	<0.001
Self-Pay	615,138	46.8%	1.20	(1.19-1.21)	<0.001
Other	53,274	37.4%	0.89	(0.87-0.91)	<0.001
Blank / Missing	162,104				
Hospital region					
Northeast	422,642	45.0%	1.00	Ref	
Midwest	650,171	50.5%	1.42	(1.42-1.41)	<0.001
South	1,154,623	46.3%	1.17	(1.17-1.18)	<0.001
West	722,374	55.7%	1.63	(1.62-1.64)	<0.001
Metropolitan status					
Non-MSA	206,505	31.4%	1.00	Ref	
MSA	2,743,305	51.2%	2.02	(2.01-2.03)	<0.001
Hospital ownership					
Voluntary	2,141,899	51.3%	1.00	Ref	
Government	362,576	37.7%	0.57	(0.568-0.574)	<0.001
Proprietary	445,335	50.5%	0.87	(0.87-0.88)	<0.001

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Unless otherwise noted, values are given as a weighted number and % of threatened abortions within each demographic segment, adjusted for demographic factors

[C]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

Table 5b. Pregnancy test use in the emergency department management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
Age (years)					
Mean	26.3		0.99	(0.99-0.99)	<0.001
Race / Ethnicity					
White	1,130,646	44%	1.00	Ref	
Black	765,931	46%	1.72	(1.71-1.73)	<0.001
Latina	443,179	43%	1.47	(1.45-1.48)	<0.001
Other[C]	145,962	43%	1.28	(1.26-1.29)	<0.001
Blank / Missing	149,410				
Insurance Type					
Private	897,623	44%	1.00	Ref	
Medicare	23,782	37%	0.69	(0.67-0.70)	<0.001
Medicaid / SCHIP	858,880	41%	1.36	(1.35-1.37)	<0.001
No charge / Charity	26,206	35%	0.20	(0.19-0.21)	<0.001
Self-Pay	637,437	49%	1.46	(1.45-1.47)	<0.001
Other	57,920	41%	0.41	(0.39-0.42)	<0.001
Blank / Missing	133,280				

Table 5b. Pregnancy test use in the emergency department management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
Hospital region					
Northeast	319,350	34%	1.00	Ref	
Midwest	622,368	48%	2.04	(2.03-2.05)	<0.001
South	1,206,450	48%	2.01	(2.00-2.05)	<0.001
West	486,960	38%	1.15	(1.15-1.16)	<0.001
Metropolitan status					
Non-MSA	205,984	31%	1.00	Ref	
MSA	2,429,144	45%	2.22	(2.20-2.23)	<0.001
Hospital ownership					
Voluntary	1,889,168	45%	1.00	Ref	
Government	374,448	39%	0.74	(0.74-0.75)	<0.001
Proprietary	371,512	42%	0.84	(0.83-0.84)	<0.001

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Unless otherwise noted, values are given as a weighted number and % of threatened abortions within each demographic segment, adjusted for demographic factors

[C]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

Table 5c. CBC use in the emergency department management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
Age (years)					
Mean	26.6		1.00	(1.00-1.00)	0.64
Race / Ethnicity					
White	1,753,793	69%	1.00	Ref	
Black	984,660	59%	0.39	(0.38-0.39)	<0.001
Latina	694,714	68%	0.85	(0.84-0.86)	<0.001
Other[C]	199,944	59%	0.50	(0.50-0.51)	<0.001
Blank / Missing	311,879				
Insurance Type					
Private	1,354,775	67%	1.00	Ref	
Medicare	47,493	74%	1.99	(1.94-2.05)	<0.001
Medicaid / SCHIP	1,292,976	62%	0.68	(0.67-0.68)	<0.001
No charge / Charity	33,551	45%	0.48	(0.47-0.49)	<0.001
Self-Pay	922,316	70%	1.08	(1.07-1.09)	<0.001
Other	75,719	53%	0.37	(0.36-0.38)	<0.001
Blank / Missing	218,160				

Table 5c. CBC use in the emergency department management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
Hospital region					
Northeast	596,733	64%	1.00	Ref	
Midwest	720,827	56%	0.68	(0.68-0.69)	<0.001
South	1,705,404	68%	1.16	(1.15-1.17)	<0.001
West	922,026	71%	1.12	(1.11-1.13)	<0.001
Metropolitan status					
Non-MSA	370,797	56%	1.00	Ref	
MSA	3,574,193	67%	1.60	(1.60-1.61)	<0.001
Hospital ownership					
Voluntary	2,767,384	66%	1.00	Ref	
Government	541,204	56%	0.57	(0.567-0.573)	<0.001
Proprietary	636,402	72%	1.18	(1.17-1.19)	<0.001

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Unless otherwise noted, values are given as a weighted number and % of threatened abortions within each demographic segment, adjusted for demographic factors

[C]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

Table 5d. OB/GYN consult use in the emergency department management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
Age (years)					
Mean	28.2		1.05	(1.05-1.05)	<0.001
Race / Ethnicity					
White	210,776	8%	1.00	Ref	
Black	136,397	8%	0.81	(0.80-0.83)	<0.001
Latina	60,238	6%	0.53	(0.52-0.54)	<0.001
Other	53,947	16%	1.13	(1.12-1.15)	<0.001
Blank / Missing	31,076				
Insurance Type					
Private	170,580	8%	1.00	Ref	
Medicare	7,995	12%	1.63	(1.58-1.68)	<0.001
Medicaid / SCHIP	131,007	6%	0.50	(0.49-0.50)	<0.001
No charge / Charity	18,827	25%	0.00	(0.00-2.02e218)	0.94
Self-Pay	118,475	9%	1.49	(1.47-1.51)	<0.001
Other	17,895	13%	0.00	(0.00-2.60e181)	0.93
Blank / Missing	27,655				
Hospital region					
Northeast	135,892	14%	1.00	Ref	
Midwest	64,801	5%	0.33	(0.32-0.33)	<0.001
South	193,239	8%	0.60	(0.60-0.61)	<0.001
West	98,502	8%	0.66	(0.65-0.67)	<0.001

Table 5d. OB/GYN consult use in the emergency department management of threatened abortions and early pregnancy loss[A,B]

	n	%	Adj OR	(95% CI)	P-val
Metropolitan status					
Non-MSA	126,688	19%	1.00	Ref	
MSA	1,081,907	20%	0.43	(0.43-0.43)	<0.001
Hospital ownership					
Voluntary	372,155	9%	1.00	Ref	
Government	74,317	8%	0.88	(0.87-0.89)	<0.001
Proprietary	45,962	5%	0.61	(0.61-0.62)	<0.001

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Unless otherwise noted, values are given as a weighted number and % of threatened abortions within each demographic segment, adjusted for demographic factors

[C]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

Our study also identified important differences in pain management based on socioeconomic and demographic factors (Table 6). Compared to white women, every other race was less likely to be treated for pain: Latina women were the least likely (OR 0.29, 95% CI 0.28-0.29), followed by black women (OR 0.46, 95% CI 0.46-0.47), and “Other” women of color (OR 0.57, 95% CI 0.57-0.58). Perhaps counterintuitively, women with Medicaid / SCHIP insurance were 13% more likely to receive pain medication compared to privately-insured women (OR 1.13, 95% CI 1.12-1.13). Women with all other types of insurance, however, were less likely to receive pain medication; patients receiving free or charity care were 0.21 times as likely to be treated for pain compared to privately-insured patients

(95% CI 0.20-0.23). Medicare-insured patients were nearly half as likely to receive pain treatment (OR 0.46, 95% CI 0.44-0.47), and patients paying out of pocket were 0.67 times as likely compared to privately-insured patients (OR 0.67, 95% CI 0.67-068). Hospitals located in all geographic regions were more likely to prescribe pain medications compared to hospitals in the Northeast, including those in the Midwest (OR 1.33, 95% CI 1.32-1.34), South (OR 1.77, 95% CI 1.76-1.78), and West (OR 2.10, 95% CI 2.08-2.11). Metropolitan hospitals were 23% more likely than non-metropolitan hospitals to treat pain in the ED (OR 1.23, 95% CI 1.23-1.24). Both government-owned hospitals (OR 1.23, 95% CI 1.22-1.24) and proprietary hospitals (OR 1.16, 95% CI 1.16-1.17) were more likely to treat pain compared to voluntary non-profit hospitals.

Table 6. Treatment of pain in threatened abortions and early pregnancy loss[A.B]

	n	%	Adj OR	(95% CI)	P-val
Age (years)					
Mean		26.8	1.00	(1.01-1.01)	<0.001
Race / Ethnicity					
White	607,942	36%	1.00	Ref	
Black	317,792	31%	0.46	(0.46-0.47)	<0.001
Latina	160,798	47%	0.29	(0.28-0.29)	<0.001
Other[C]	59,580	14%	0.57	(0.57-0.58)	<0.001
Blank / Missing	62,483				
Insurance Type					
Private	398,977	20%	1.00	Ref	
Medicare	4,700	7%	0.46	(0.44-0.47)	<0.001

Medicaid / SCHIP	482,281	23%	1.13	(1.12-1.13)	<0.001
No charge / Charity	14,179	19%	0.21	(0.20-0.23)	<0.001
Self-Pay	223,713	17%	0.67	(0.67-0.68)	<0.001
Other	50,653	36%	2.32	(2.26-2.37)	<0.001
Blank / Missing	34,092				<0.001
Hospital region					
Northeast	125,177	13%	1.00	Ref	
Midwest	227,663	18%	1.33	(1.32-1.34)	<0.001
South	539,418	22%	1.77	(1.76-1.78)	<0.001
West	316,337	24%	2.10	(2.08-2.11)	<0.001
Metropolitan status					
Non-MSA	126,688	19%	1.00	Ref	
MSA	1,081,907	20%	1.23	(1.23-1.24)	<0.001
Hospital ownership					
Voluntary	779,699	19%	1.00	Ref	
Government	218,777	23%	1.23	(1.22-1.24)	<0.001
Proprietary	210,119	24%	1.16	(1.16-1.17)	<0.001

[A]Includes threatened abortions, spontaneous abortions except complete abortions, and hemorrhage in pregnancy

[B]Unless otherwise noted, values are given as a weighted number and % of threatened abortions within each demographic segment, adjusgted for demographic factors

[C]Includes Asian, Native Hawaiian, Native Alaskan, Native American, 1+ race recorded

Discussion

The definition of “health disparity” varies across multiple institutions. The World Health Organization (WHO) uses the broadest definition, citing “disparities”

as “differences in health which are not only unnecessary and avoidable but, in addition, are considered unfair and unjust [35].” The Agency for Healthcare Research and Quality (AHRQ) cites disparities where any statistically significant differences among populations are found, differing from the reference group by at least 10 percent [36]. Here we use both of these definitions when referencing “healthcare disparities”. Given the limited data on clinical picture and patient preference within the NHAMCS, our use of “healthcare disparities” does not align with the Institute of Medicine (IOM) definition: “racial or ethnic differences in the quality of health-care that are not due to access-related factors or clinical needs, preferences, and appropriateness of intervention” [46].

Racial and socioeconomic disparities are known to exist within obstetrics and gynecology. These span from maternal morbidities [47] and delivery complications [48] to poor obstetric outcomes, where uninsured and minority women are more likely to experience preterm births, low birth weights, and intrauterine fetal loss [49-54]. Similar racial/ethnic and socioeconomic disparities have also been identified in spontaneous abortion. Compared to white women, black women may be twice as likely to experience miscarriage [26]. Nonwhite women may be four times as likely to die from spontaneous abortion [22]. Disparate pregnancy outcomes have been attributed to differences in healthcare access [27, 28] and healthcare-seeking behaviors [30-32] among marginalized populations, or even provider bias [46]. However, recent studies have also identified racially-based differences in the management of obstetrics problems – such as the medical and surgical treatment of ectopic pregnancy [27, 55].

Similarly, our study sought to identify disparities in management of incomplete and delayed spontaneous abortion, collectively referenced here as non-complete spontaneous abortion here, as well as threatened abortion – which can lead to miscarriage in 50% of cases [2].

We found that racial and socioeconomic differences indeed exist, even among different minority groups. Firstly, several minority and historically-vulnerable groups were more likely to be admitted for threatened abortion, compared to white and privately-insured women. These included “Other” women of color (Asian, Native American, Native Hawaiian, Native Alaskan, and mixed race), uninsured women, and Medicaid-insured women. Regardless of disposition, active treatment was more common among uninsured women, black women, and “Other” women of color, compared to white and privately-insured women. Note that although these odds ratios were statistically significant, they do reflect only a small subset of our cohort. Expectant management was by far the most preferred treatment modality in our cohort, which is reasonable given that diagnoses ranged from early pregnancy hemorrhage to spontaneous abortion.

The decision to admit or actively treat threatened and spontaneous abortion is multifactorial. It may be influenced by clinical complexity, patient preference, or decisions at provider level – introducing potential subjectivity or biases. Our findings are consistent with previous studies, which have also suggested that providers opt to “actively” treat nonwhite women and women at risk for poor obstetrics outcomes. C-sections, for instance, are an “active” form of managing pregnancy that is performed at a higher rate among nonwhite women

[37]. Asian and “Other” women of color are more likely to receive surgery instead of nonsurgical treatment for ectopic pregnancy, compared to white women [27]. Low-income, nonprivately insured, black, and Latina women are less likely to undergo the less invasive surgery, laparoscopic hysterectomy, versus open hysterectomy compared to white women [38]. Surgical sterilization is used in nearly one fifth of sexually active black and Latina women desiring contraception, compared to only 16% of white women, who are more likely to use oral contraceptives [56]. Surgical abortions, instead of medical, may be preferentially recommended to low income, non-English-speaking women seeking elective abortion [57]. Note that in our study, both surgery and misoprostol are considered “active” ways to manage *spontaneous* abortion. *Elective* abortions, however, cannot be treated expectantly. Therefore, in receiving counsel to choose surgical over medical management, these populations are offered the more “active” of the two treatments options.

In choosing a mode of management, providers’ concerns range from poor adherence, loss to follow-up, miscommunication, or low medical literacy. Expectant management, for instance, often results in follow-up visits, as nearly 70% of women request surgery by two weeks post-diagnosis [45]. In the setting of incomplete abortion, expectant management has also been found to result in more frequent unscheduled visits, hospital admissions, and need for curettage compared to medically induced abortion, according to another, single-site study [58]. Providers may view admission or active management as a definitive way to preempt adverse maternal or neonatal outcomes in at-risk populations.

This line of reasoning for candidate selection has been studied and even recommended in other obstetrics outcomes. Jasper et al (2010) and Duenas-Garcia et al (2013) suggest that patient compliance should be considered when choosing between methotrexate and surgery, the more active of the two treatment modalities for ectopic pregnancy. Both studies found low rates of methotrexate compliance in inner-city patients presenting with ectopic pregnancy [55, 59]. Specifically, compared with treatment success rates of 85% in appropriately selected subjects, only 19.7% patients at Albert Einstein Medical Center from 2004-2007 complied with a single-dose regimen. Even after intensive efforts to encourage follow-up including multiple phone calls and reminders, less than half of women were followed to resolution [55]. Duenas-Garcia et al (2013) found similar rates (10.1%) of noncompliance in a Bronx-based study of predominantly black and Latina women, where noncompliance was defined as missing three or more visits and requiring recall by telephone or telegram [59]. Both studies suggest that providers should, in fact, consider compliance in selecting appropriate candidates for medical treatment in ectopic pregnancy. The implication is that women who are not candidates would instead be recommended for surgical treatment, reinforcing the practice of using active management to mitigate risk for adverse outcomes.

Although considerations of compliance often affect treatment decisions, limited studies have examined compliance in the setting of treatment for spontaneous abortion. Among a predominantly white group of 100 women [58] and 550 patients in Sweden [11], compliance was found to be high, with very few

women opting to undergo surgery. However, these studies did not examine the rates of adherence to follow-up appointments. They were also performed using a small sample size, and provided limited information regarding the racial/ethnic or socioeconomic composition of the study populations. Future studies might compare treatment modalities and their rates of compliance, complications, and other outcomes within at-risk populations.

Our study also identified several unexpected relationships between socioeconomic variables and threatened abortion management. Unlike other minority groups, black women were less likely to be admitted compared to white women. The disparity may be even greater than reflected here when including patients who were admitted directly to the hospital from their outpatient providers. These patients are likely comprised of mostly white patients; black patients tend to seek care in outpatient settings less often, instead obtaining care from emergency department and inpatient settings [60].

In contrast to black women, “Other” women of color actually had double the chance of admission compared to whites. With these findings in mind, underrepresented groups might be expected to exhibit similar patterns in management. One possible explanation is patient preference. Many immigrant, minority, low-income, and other marginalized groups have suffered severe injustices within obstetrics [61, 62]. However, black patients may experience a disparate degree of distrust in the medical system [63], resultantly affecting their preferences in management. Additionally, “Other” women of color may face the added risk factor of more significant language barriers, which may contribute to

increased likelihood of admission. Asian-language speakers in Hawaii, for instance, experience higher rates of obstetric complications – an effect that has been mitigated in other countries with the use of interpreters [64, 65]. To avoid complications arising from miscommunication and loss to follow-up [46], providers may attempt to admit and actively manage these patients. Note, however, that stereotyped beliefs about women of color may also cause providers to perceive or assume presence of a language barrier [46]. The presumption alone of a language barrier may also influence provider-based decisions on treatment modality.

This explanation, however, does not account for our findings regarding Latina patients. Latina women were the only minority group less likely to undergo active treatment compared to white women, which may seem counterintuitive. Like other minorities and marginalized populations, Latina women face adverse social risk factors: delayed access to prenatal care, language barriers, and lower socioeconomic status. However, Latina women actually experience better birth outcomes compared to blacks – an epidemiological finding documented as the Hispanic Paradox [32, 66-68]. With such notable discrepancies in outcomes, it seems possible that differences in management contribute in some capacity.

Moreover, Latinas have also demonstrated lower rates of active management in pregnancy. Rates of CS from 1996-2006 increased for every race, but increased the least for Latinas. For over two decades, Latina women persistently have had one of the lowest CS rates among multiple racial/ethnic

groups [32]. A nine-year, nationwide study of ectopic pregnancy among 35,000 women found that Latinas were the only racial/ethnic group more likely to receive nonsurgical versus surgical management compared to white women [27]; however, results for Latina and black women may not have been statistically significant (p-values > 0.05). Nevertheless, our explanations ultimately remain speculative. Many factors contribute to the process of medical decision-making, which renders our findings difficult to explain. Note, however, that one single-site study found that Latinas discharged from obstetrical services were 3.6 times as likely to report a lack of respect for their preferences, when compared to whites (OR 3.6; CI 1.6-8.2) [69]. In this context, one must consider that discrepancies in the obstetric management of Latina women may not, in fact, be entirely patient-driven.

Race/ethnicity or insurance provider was not associated with any consistent patterns of usage across multiple diagnostic tests, which is perhaps a more meaningful way to identify demographically-based discrepancies in work-up. Geographic location of emergency department, however, was another significant variable that influenced disposition, management, use of OB/GYN consult, and pain management. Specifically, we found that hospitals located in the Northeast region were more likely to admit, actively manage, and utilize a consulting physician for threatened abortion, compared to EDs in all other US regions. In general, rates of inpatient admission from the ED are higher in the Northeast compared to all other regions [70]. More specific studies on ED admission and discharge for obstetrics-related diagnoses were highly limited;

however, an older study on acute and unspecified pelvic inflammatory disease from 1985-2001 found that Southern outpatient departments actually had the highest rates of hospitalization, followed closely by Northeastern and Midwestern hospitals. Our finding that Northeastern hospitals demonstrate higher rates of admission or active management is complicated to interpret without additional context. For instance, regional variability may exist with respect to availability of inpatient beds, accessibility to consulting physicians, or even patient characteristics like severity or gestational age at presentation – which are associated with race/ethnicity and socioeconomic status.

Lastly, our study found that all groups of nonwhite women, Medicaid-insured women, and uninsured women were all far less likely to receive pain medication compared to white and privately-insured women. The undertreatment of painful conditions, or oligoanalgesia, in the emergency department and other settings has been well-documented since the late 1980s [71]. Demographic risk factors for oligoanalgesia are also widely known, including age, race/ethnicity, socioceconomic status, and geographic location of the hospital [72]. These disparities exist across various types of pain and conditions. An NHAMCS study on 175,351 ED visits for acute abdominal pain over five years found that black patients and patients of other races/ethnicities were 17-30% less likely to receive narcotic analgesia ($p<0.05$) and 22-30% less likely to receive analgesia (OR (95% CI)=0.78 (0.67–0.90); 0.70 (0.56–0.88)) compared to non-Hispanic white patients with similar complaints [73]. Todd et al (1993) found that Hispanics with long-bone fractures were twice as likely as comparably-injured white patients to

receive no pain medication [74]; blacks with isolated long-bone fractures were also less likely to receive analgesics compared to their white counterparts [75]. Blacks with migraine headaches and back pain may receive less intensive diagnostic work-up [76] and less opioid treatment [77]. Regarding post-surgical pain, another study on post-surgical narcotic use found that whites received higher prescriptions of morphine compared to Hispanics and Asians, even after controlling for age, gender, previous narcotic use, and pain site [78]; the same study found that blacks were prescribed a higher opioid dose than Hispanics and Asians.

Oligoanalgesia has also been studied specifically in obstetrics. One single-site study of 3,000 women found that when English was *not* the patient's preferred language, obstetrics patients were 0.82 as likely to receive neuraxial labor analgesia (OR 0.82, 95% CI 0.67-0.99) [79]. Multiple other studies have also shown racial disparities in epidural analgesia use. For instance, even after adjusting for insurance status, provider effect, and clinical differences, one retrospective cohort study of 80,000 patients showed that black and Latina were less likely to receive epidural analgesia compared to white patients [80]. Similar findings were demonstrated in another study of nearly 30,000 Medicaid-insured obstetrics patients, where rates of epidural analgesia use were lower in black (49.5%), Hispanic (35.3%), and Asian (48.1%) women compared to white, non-Hispanic women (59.6%, $p<0.001$) [81]. This persisted even after adjusting for age, geographical location, and access to anesthesiologists. Educational level has also been identified as an influential factor in receiving labor analgesia,

where graduation from high school was strongly associated with requesting epidural [82].

A variety of factors may contribute to these disparities in pain treatment, within obstetric as well as other conditions. Treatment of pain in the ED also involves multi-step communication between several parties. The patient must perceive and express pain, sometimes through a family member or other advocate, to the provider, which may include nurse and physician. While several studies have not identified differences in the perception of pain across races/ethnicities [83, 84], racial/ethnic or cultural variations in the *expression* of pain may indeed exist [83]. On the provider's end, whether or not the provider perceives an exaggeration of pain has been found to differ based on the patient's ethnicity, ultimately affecting the achievement of pain relief [85].

Additionally, differences in patients' degree of knowledge about pain treatment options or health literacy may affect pain treatment, as suggested by the association between educational level and requesting epidural in labor epidural [82]. Note, however, that one study found disparities in prescription for opioid pain treatment despite similar subjective pain scores, expectations for pain relief, and knowledge of PCA [78]. Fear of side effects of treatment or varying cultural beliefs regarding pain and suffering may also influence pain treatment [86]. Patients may also experience extrinsic pressure from family or healthcare providers [46], though interestingly, one small study found that minorities were actually more likely to feel pressured by their providers to accept analgesia in labor [87]. Language barriers may also contribute [79], although other studies

have found that ethnicity influences pain treatment regardless of language [74]. Other influential factors on pain treatment may include true drug-seeking among patients, the perception of drug-seeking behavior in a patient, inadequate provider training, or racial stereotyping.

Limitations:

Several important limitations affected our study. Firstly, this was a retrospective study using aggregate data from various emergency department settings across the country. This excludes data on management after hospital admission or within private clinics, where threatened abortions can be admitted directly to the hospital or simply treated on-site. Additionally, our study collapsed Asians, Native Alaskans, Native Hawaiians, and mixed race women into one group due to small sample size. We appreciate the heterogeneity of women that comprise this group, which poses limitations to any conclusions drawn after grouping “Other” women of color collectively.

In using administrative data, our study was limited by unknown errors in the input or documentation of race, income, insurance providers, procedures, or medications. Without data from individual charts, the study is also unable to capture physician or patient preferences in the medical decision-making process. Of note, “admission to the OR” was not a recordable disposition from 2002-2004. As this disposition was used to identify surgical treatment, the proportion of cases managed “actively” to “expectantly” may be even greater. Moreover, we cannot be certain of the extent to which differences in management translate to clinical differences, as patient outcomes were not examined in this study.

Importantly, our findings could not incorporate considerations of gestational age at presentation, a data point not recorded in NHAMCS. Management decisions may vary with gestational age: a second-term hemorrhage is more likely to warrant admission or surgery than minor, first-term bleeding. If a racially-based disparity existed with respect to gestational age at presentation, our study would have only captured the resulting disparity in treatment. Here we find that black women are more likely to be discharged; perhaps they simply experience a disproportionately high occurrence of minor, early-term vaginal bleeding. However, given that black women tend to delay seeking prenatal care [27, 28], it seems more likely they would present at a later gestational age compared to white women. Of note, ACOG guidelines recommend limiting expectant management to presentation within the first trimester [9]. Furthermore, the risk of spontaneous abortion-related death increases for women presenting at later gestational age [22].

Conclusion:

In spite of these limitations, our study also has a number of strengths. Firstly, it is a population-based sample reflective of cases nationwide. Secondly, the dataset is extremely large, including over five million (weighted) cases of threatened abortion, incomplete abortion, delayed abortion, and other hemorrhage in pregnancy over a nine-year period (2002-2010). Together, these characteristics allowed for appropriate generalization when identifying demographically-based disparities in management among women in the United States. While individual chart review may have added more granular detail to our

findings, the relationships identified here may not have been elicited in a smaller or single-site study. Finally, we used data aggregated in the NHAMCS, administered by the Centers for Disease Control and Prevention, National Center for Health Statistics. Specially trained interviewers collect data provided by the physician rather than patients, providing a clinical base. The NHAMCS is also the largest extant national emergency department database, further strengthening our study's findings.

The demographically-based disparities in management identified in our study echo other documented differences within reproductive health. The etiology of these disparities is complex, but may reveal persistent barriers to communication and healthcare access. If providers are indeed using admission or active management to mitigate true or perceived risks in a population, perhaps additional resources should be directed towards improving patients' social support, follow-up, or adherence. Providers may also seek to better understand their own stereotypes or preconceptions of patient risk, and work towards strengthening communication and shared decision-making.

References

1. Snell, B.J., *Assessment and Management of Bleeding in the First Trimester of Pregnancy.* The Journal of Midwifery & Women's Health, 2009. **54**(6): p. 483-491.
2. Marx, J., Hochberger RS, Walls RM, *Rosen's emergency medicine: concepts and clinical practice*. 5th ed ed. 2002, St Louis, MO Mosby, Inc.
3. Poulose, T., et al., *Probability of early pregnancy loss in women with vaginal bleeding and a singleton live fetus at ultrasound scan.* Journal of Obstetrics & Gynaecology, 2006. **26**(8): p. 782-784.
4. *Abortion Surveillance Report*. 1985, Centers for Disease Control: Atlanta, GA.
5. Allison, J.L., R.S. Sherwood, and D.J. Schust, *Management of First Trimester Pregnancy Loss Can Be Safely Moved Into the Office.* Rev Obstet Gynecol, 2011. **4**(1): p. 5-14.
6. Griebel, C.P., et al., *Management of spontaneous abortion.* Am Fam Physician, 2005. **72**(7): p. 1243-50.
7. Jauniaux, E., J. Johns, and G.J. Burton, *The role of ultrasound imaging in diagnosing and investigating early pregnancy failure.* Ultrasound Obstet Gynecol, 2005. **25**(6): p. 613-24.
8. Nanda K, L.L., Grimes DA, Peloggia A, Nanda G, *Expectant care versus surgical treatment for miscarriage.* Cochrane Database of Systematic Reviews, 2012(3).
9. *The American College of Obstetricians and Gynecologists Practice Bulletin no. 150. Early pregnancy loss.* Obstet Gynecol, 2015. **125**(5): p. 1258-67.
10. Doubilet, P.M., et al., *Diagnostic criteria for nonviable pregnancy early in the first trimester.* N Engl J Med, 2013. **369**(15): p. 1443-51.
11. Nielsen S, H.M., *Expectant management of first-trimester spontaneous abortion.* The Lancet, 1995. **345**(8942): p. 84-85.

12. Wieringa-de Waard M, V.J., Bonsel GJ, Bindels PJ, Ankum WM, *Management of miscarriage: a randomized controlled trial of expectant versus surgical evacuation.* Human Reproduction, 2002. **17**: p. 2445-2450.
13. Forna F, G.A., *Surgical procedures to evacuate incomplete miscarriage.* Cochrane Database of Systematic Reviews 2001(1).
14. Blumenthal, P.D. and R.E. Remsburg, *A time and cost analysis of the management of incomplete abortion with manual vacuum aspiration.* Int J Gynaecol Obstet, 1994. **45**(3): p. 261-7.
15. Shannon, C., et al., *Infection after medical abortion: A review of the literature.* Contraception, 2004. **70**(3): p. 183-190.
16. Chung, T.K.H., et al., *Misoprostol in the management of spontaneous abortion.* BJOG: An International Journal of Obstetrics & Gynaecology, 1995. **102**(10): p. 832-835.
17. Henshaw RC, C.K., El-Refaey H, Smith NC, Templeton AA, *Medical management of miscarriage: non-surgical uterine evacuation of incomplete and inevitable spontaneous abortion.* BMJ, 1993. **306**: p. 894-895.
18. Edwards, S., et al., *Patient acceptability of manual versus electric vacuum aspiration for early pregnancy loss.* J Womens Health (Larchmt), 2007. **16**(10): p. 1429-36.
19. Tamizian, O. and S. Arulkumaran, *Bleeding in early pregnancy.* Current Obstetrics & Gynaecology, 2004. **14**(1): p. 23-33.
20. Brown, S., *Miscarriage and Its Associations.* Semin Reprod Med, 2008. **26**(05): p. 391-400.
21. Wang, X., et al., *Conception, early pregnancy loss, and time to clinical pregnancy: a population-based prospective study.* Fertility and Sterility, 2003. **79**(3): p. 577-584.

22. Saraiya, M., et al., *Spontaneous abortion-related deaths among women in the United States--1981-1991.* Obstet Gynecol, 1999. **94**(2): p. 172-6.

23. Wilcox, A.J., *Surveillance of pregnancy loss in human populations.* Am J Ind Med, 1983. **4**(1-2): p. 285-91.

24. Prevention, C.f.D.C.a. *Pregnancy Mortality Surveillance System*. 2010; Available from: http://www.cdc.gov/reproductivehealth/maternalinfanthealth/pmss.html.

25. Healy, A.J., et al., *Early Access to Prenatal Care: Implications for Racial Disparity in Perinatal Mortality.* Obstetrics & Gynecology, 2006. **107**(3): p. 625-631 10.1097/01.AOG.0000201978.83607.96.

26. Mukherjee, S., et al., *Risk of miscarriage among black women and white women in a U.S. Prospective Cohort Study.* Am J Epidemiol, 2013. **177**(11): p. 1271-8.

27. Papillon-Smith, J., et al., *Population-based study on the effect of socioeconomic factors and race on management and outcomes of 35,535 inpatient ectopic pregnancies.* J Minim Invasive Gynecol, 2014. **21**(5): p. 914-20.

28. Rowley, D.L., et al., *Preterm delivery among African-American women: a research strategy.* Am J Prev Med, 1993. **9**(6 Suppl): p. 1-6.

29. DeNavas-Walt, C., B.D. Proctor, and J.C. Smith, *Income, Poverty, and Health Insurance Coverage in the United States: 2007*, in *Current Population Reports*, U.C. Bureau, Editor. 2008, U.S. Government Printing Office: Washington, DC.

30. *Health, United States, 2009: With Special Feature on Medical Technology*. 2010, Hyattsville MD.

31. Atrash, H.K., A. Friede, and C.J. Hogue, *Ectopic pregnancy mortality in the United States, 1970-1983.* Obstet Gynecol, 1987. **70**(6): p. 817-22.

32. Martin, J.A., et al., *Births: final data for 2008.* Natl Vital Stat Rep, 2010. **59**(1): p. 1, 3-71.

33. Asplin, B.R., et al., *Insurance status and access to urgent ambulatory care follow-up appointments.* JAMA, 2005. **294**(10): p. 1248-1254.

34. McWilliams, J.M., et al., *Use of Health Services by Previously Uninsured Medicare Beneficiaries.* New England Journal of Medicine, 2007. **357**(2): p. 143-153.

35. Whitehead, M., *The concepts and principles of equity and health.* Health Promotion International, 1991. **6**(3): p. 217-228.

36. *2014 National Healthcare Quality & Disparities Report*. 2015, Agency for Healthcare Research and Quality: Rockville, MD.

37. MacDorman, M.F., F. Menacker, and E. Declercq, *Cesarean birth in the United States: epidemiology, trends, and outcomes.* Clin Perinatol, 2008. **35**(2): p. 293-307, v.

38. Abenhaim, H.A., et al., *Socioeconomic and racial predictors of undergoing laparoscopic hysterectomy for selected benign diseases: analysis of 341487 hysterectomies.* J Minim Invasive Gynecol, 2008. **15**(1): p. 11-5.

39. Hajenius PJ, M.F., Mol BW, Bossuyt PM, Ankum WM, van der Veen F, *Interventions for tubal ectopic pregnancy.* Cochrane Database Syst Rev, 2007. **24**.

40. KT, B., *Clinical practice. Ectopic pregnancy.* New England Journal of Medicine, 2009. **361**(4): p. 379-387.

41. Mol F, M.B., Ankum WM, van derVeen F, Hajenius PJ, *Current evidence on surgery, systemic methotrexate and expectant management in the treatment of tubal ectopic pregnancy: a systematic review and meta-analysis.* Hum Reprod Update, 2008. **14**: p. 309-319.

42. Creanga, A.A., et al., *Trends in ectopic pregnancy mortality in the United States: 1980-2007.* Obstet Gynecol, 2011. **117**(4): p. 837-43.

43. Sotiriadis, A., et al., *Expectant, Medical, or Surgical Management of First-Trimester Miscarriage: A Meta-Analysis.* Obstetrics & Gynecology, 2005. **105**(5, Part 1): p. 1104-1113.

44. Zhang, J., et al., *A comparison of medical management with misoprostol and surgical management for early pregnancy failure.* N Engl J Med, 2005. **353**(8): p. 761-9.

45. Bagratee JS, K.V., Regan L, Moodley J, and Kagoro H, *A randomized controlled trial comparing medical and expectant management of first trimester miscarriage.* Hum. Reprod, 2003. **19**(2): p. 266-271.

46. in *Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care*, B.D. Smedley, A.Y. Stith, and A.R. Nelson, Editors. 2003, 2002 by the National Academy of Sciences: Washington DC.

47. Cabacungan, E.T., E.M. Ngui, and E.L. McGinley, *Racial/ethnic disparities in maternal morbidities: a statewide study of labor and delivery hospitalizations in Wisconsin.* Matern Child Health J, 2012. **16**(7): p. 1455-67.

48. Guendelman, S., et al., *Obstetric complications during labor and delivery: assessing ethnic differences in California.* Womens Health Issues, 2006. **16**(4): p. 189-97.

49. Anderson, J.E., *Access to obstetric care in the United States from the National Health Interview Survey.* Soc Work Public Health, 2014. **29**(2): p. 141-7.

50. Chang, J., et al., *Pregnancy-related mortality surveillance--United States, 1991--1999.* MMWR Surveill Summ, 2003. **52**(2): p. 1-8.

51. Kent, S.T., et al., *Area-level risk factors for adverse birth outcomes: trends in urban and rural settings.* BMC Pregnancy Childbirth, 2013. **13**: p. 129.

52. Koonin, L.M., et al., *Pregnancy-related mortality surveillance--United States, 1987-1990.* MMWR CDC Surveill Summ, 1997. **46**(4): p. 17-36.

53. Stephansson, O., et al., *The influence of socioeconomic status on stillbirth risk in Sweden.* Int J Epidemiol, 2001. **30**(6): p. 1296-301.

54. Tucker, M.J., et al., *The Black-White disparity in pregnancy-related mortality from 5 conditions: differences in prevalence and case-fatality rates.* Am J Public Health, 2007. **97**(2): p. 247-51.

55. Jaspan, D., et al., *Compliance with methotrexate therapy for presumed ectopic pregnancy in an inner-city population.* Fertil Steril, 2010. **94**(3): p. 1122-4.

56. Mosher, W.D., et al., *Use of contraception and use of family planning services in the United States: 1982-2002.* Adv Data, 2004(350): p. 1-36.

57. Teal, S.B., et al., *Efficacy, acceptability and safety of medication abortion in low-income, urban Latina women.* Contraception, 2009. **80**(5): p. 479-83.

58. Pauleta, J.R., N. Clode, and L.M. Graça, *Expectant management of incomplete abortion in the first trimester.* International Journal of Gynecology & Obstetrics, 2009. **106**(1): p. 35-38.

59. Dueñas-Garcia, O.F., et al., *Compliance with follow-up in an inner-city population treated with intramuscular methotrexate for suspected ectopic pregnancy.* International Journal of Gynecology and Obstetrics. **120**(3): p. 254-256.

60. Bach, P.B., et al., *Primary care physicians who treat blacks and whites.* N Engl J Med, 2004. **351**(6): p. 575-84.

61. Shapiro, T.M., W. Fisher, and A. Diana, *Family planning and female sterilization in the United States.* Soc Sci Med, 1983. **17**(23): p. 1847-55.

62. Stern, A.M., *Sterilized in the name of public health: race, immigration, and reproductive control in modern California.* Am J Public Health, 2005. **95**(7): p. 1128-38.

63. Benkert, R., et al., *Effects of perceived racism, cultural mistrust and trust in providers on satisfaction with care.* J Natl Med Assoc, 2006. **98**(9): p. 1532-40.

64. Parsons, L. and S. Day, *Improving obstetric outcomes in ethnic minorities: an evaluation of health advocacy in Hackney.* J Public Health Med, 1992. **14**(2): p. 183-91.

65. Small, R., et al., *Mothers in a new country: the role of culture and communication in Vietnamese, Turkish and Filipino women's experiences of giving birth in Australia.* Women Health, 1999. **28**(3): p. 77-101.

66. *Racial/ethnic disparities in infant mortality--United States, 1995-2002.* MMWR Morb Mortal Wkly Rep, 2005. **54**(22): p. 553-6.

67. Bryant, A.S., et al., *Racial/Ethnic Disparities in Obstetrical Outcomes and Care: Prevalence and Determinants.* Am J Obstet Gynecol, 2010. **202**(4): p. 335-43.

68. Zambrana, R.E., et al., *Mediators of ethnic-associated differences in infant birth weight.* J Urban Health, 1999. **76**(1): p. 102-16.

69. Hicks, L.S., et al., *Is hospital service associated with racial and ethnic disparities in experiences with hospital care?* Am J Med, 2005. **118**(5): p. 529-35.

70. Owens, P.L., et al., *Emergency department care in the United States: a profile of national data sources.* Annals of emergency medicine, 2010. **56**(2): p. 150-165.

71. Wilson, J.E. and J.M. Pendleton, *Oligoanalgesia in the emergency department.* Am J Emerg Med, 1989. **7**(6): p. 620-3.

72. Green, C., et al., *Disparities in Pain: Ethical Issues.* Pain Medicine, 2006. **7**(6): p. 530-533.

73. Shah, A.A., et al., *Analgesic Access for Acute Abdominal Pain in the Emergency Department Among Racial/Ethnic Minority Patients: A Nationwide Examination.* Med Care, 2015. **53**(12): p. 1000-9.

74. Todd, K.H., N. Samaroo, and J.R. Hoffman, *Ethnicity as a risk factor for inadequate emergency department analgesia.* JAMA, 1993. **269**(12): p. 1537-9.

75. Todd, K.H., et al., *Ethnicity and analgesic practice.* Annals of Emergency Medicine, 2000. **35**(1): p. 11-16.

76. Carey, T.S. and J.M. Garrett, *The relation of race to outcomes and the use of health care services for acute low back pain.* Spine (Phila Pa 1976), 2003. **28**(4): p. 390-4.

77. Tamayo-Sarver, J.H., et al., *Racial and ethnic disparities in emergency department analgesic prescription.* Am J Public Health, 2003. **93**(12): p. 2067-73.

78. Ng, B., et al., *The effect of ethnicity on prescriptions for patient-controlled analgesia for post-operative pain.* Pain, 1996. **66**(1): p. 9-12.

79. Caballero, J.A., et al., *Preferred spoken language mediates differences in neuraxial labor analgesia utilization among racial and ethnic groups.* Int J Obstet Anesth, 2014. **23**(2): p. 161-7.

80. Glance, L.G., et al., *Racial differences in the use of epidural analgesia for labor.* Anesthesiology, 2007. **106**(1): p. 19-25; discussion 6-8.

81. Rust, G., et al., *Racial and ethnic disparities in the provision of epidural analgesia to Georgia Medicaid beneficiaries during labor and delivery.* Am J Obstet Gynecol, 2004. **191**(2): p. 456-62.

82. Orejuela, F.J., et al., *Exploring factors influencing patient request for epidural analgesia on admission to labor and delivery in a predominantly Latino population.* J Immigr Minor Health, 2012. **14**(2): p. 287-91.

83. Greenwald, H.P., *Interethnic differences in pain perception.* Pain, 1991. **44**(2): p. 157-163.

84. Zatzick, D.F. and J.E. Dimsdale, *Cultural variations in response to painful stimuli.* Psychosom Med, 1990. **52**(5): p. 544-57.

85. Miner, J., et al., *Patient and physician perceptions as risk factors for oligoanalgesia: a prospective observational study of the relief of pain in the emergency department.* Acad Emerg Med, 2006. **13**(2): p. 140-6.

86. Davitz, L.J., Y. Sameshima, and J. Davitz, *Suffering as Viewed in Six Different Cultures.* The American Journal of Nursing, 1976. **76**(8): p. 1296-1297.

87. Morris, T. and M. Schulman, *Race inequality in epidural use and regional anesthesia failure in labor and birth: an examination of women's experience.* Sex Reprod Healthc, 2014. **5**(4): p. 188-94.