Journal of Midwifery & Women's Health www.jmwh.org
Original Research

Outcomes of Care for 16,924 Planned Home Births in the United States: The Midwives Alliance of North America Statistics Project, 2004 to 2009

Melissa Cheyney, PhD, CPM, LDM, Marit Bovbjerg, PhD, MS, Courtney Everson, MA, Wendy Gordon, MPH, CPM, LM, Darcy Hannibal, PhD, Saraswathi Vedam, CNM, MSN, RM

Introduction: Between 2004 and 2010, the number of home births in the United States rose by 41%, increasing the need for accurate assessment of the safety of planned home birth. This study examines outcomes of planned home births in the United States between 2004 and 2009.

Methods: We calculated descriptive statistics for maternal demographics, antenatal risk profiles, procedures, and outcomes of planned home births in the Midwives Alliance of North American Statistics Project (MANA Stats) 2.0 data registry. Data were analyzed according to intended and actual place of birth.

Results: Among 16,924 women who planned home births at the onset of labor, 89.1% gave birth at home. The majority of intrapartum transfers were for failure to progress, and only 4.5% of the total sample required oxytocin augmentation and/or epidural analgesia. The rates of spontaneous vaginal birth, assisted vaginal birth, and cesarean were 93.6%, 1.2%, and 5.2%, respectively. Of the 1054 women who attempted a vaginal birth after cesarean, 87% were successful. Low Apgar scores (< 7) occurred in 1.5% of newborns. Postpartum maternal (1.5%) and neonatal (0.9%) transfers were infrequent. The majority (86%) of newborns were exclusively breastfeeding at 6 weeks of age. Excluding lethal anomalies, the intrapartum, early neonatal, and late neonatal mortality rates were 1.30, 0.41, and 0.35 per 1000, respectively.

Discussion: For this large cohort of women who planned midwife-led home births in the United States, outcomes are congruent with the best available data from population-based, observational studies that evaluated outcomes by intended place of birth and perinatal risk factors. Low-risk women in this cohort experienced high rates of physiologic birth and low rates of intervention without an increase in adverse outcomes.
J Midwifery Womens Health 2014;59:17–27

Keywords: birth place, home childbirth, midwife, midwifery, perinatal outcome, pregnancy outcomes

INTRODUCTION

In the United States, approximately 1% of all births occur in homes and birth centers, and these births are attended primarily by direct-entry midwives (DEMs), including certified professional midwives (CPMs).[1] Of the 1.18% of US births occurring outside of the hospital in 2010, approximately 66% (31,500) were home births. Although a small proportion of total births in the United States, home births are on the rise. After a steady decline between 1990 and 2004, home births increased by 41% between 2004 and 2010, up from 0.56% to 0.79%, with 10% of this increase occurring between 2009 and 2010.[1] By comparison, in Great Britain and the Netherlands 8% and 29% of women, respectively, give birth outside of an obstetric unit.[2,3]

Data on outcomes from planned home births in the United States have not been reported in the peer-reviewed literature since 2005,[4] when Johnson and Daviss described outcomes for 5418 home births attended by CPMs in 2000. In 2004, the Midwives Alliance of North American (MANA) division of research developed a Web-based data collection system (the MANA Statistics Project [MANA Stats]) for the purpose of collecting information on a large, multiyear, voluntary sample of midwife-led births occurring primarily at home and in birth centers within the United States.[5] This study describes outcomes from planned home births recorded in the MANA Stats database (version 2.0) from 2004 to 2009.

Address correspondence to Melissa Cheyney, PhD, CPM, LDM, Department of Anthropology, Oregon State University, Waldo Hall 238, Corvallis, OR 97331. E-mail: melissa.cheyney@oregonstate.edu

BACKGROUND

A complete understanding of the safety of planned home and birth center birth is difficult to achieve. To date, universal perinatal data are only available in the United States through birth certificates, which are unreliable with respect to information on the intended and the actual place of birth.[6–8] Until recently, high-quality data comparing outcomes by birth setting were not available because many published studies failed to reliably distinguish among intended and actual place of birth, type of attendant, and maternal risk profiles. Despite attempts to design a randomized controlled trial, sufficient numbers of women have not consented to be randomized according to birth site.[9]

In 2009, 3 well-designed, population-based cohort studies were published comparing planned home births to planned hospital births with professional midwives as attendants. In the first study, de Jonge and colleagues[10] used a national dataset (N = 529,688) of low-risk pregnancies in the Netherlands to compare perinatal mortality and morbidity outcomes for planned home (60.7%) and hospital births (30.8%) between 2000 and 2006. There were no significant differences in intrapartum death, neonatal death within 24 hours or 7 days

1526-9523/09/$36.00 doi:10.1111/jmwh.12172

Quick Points

- ✦ This study reports maternal and neonatal outcomes for women planning to give birth at home under midwife-led care, as recorded in the Midwives Alliance of North America Statistics Project dataset (version 2.0, birth years 2004-2009).
- ✦ Among 16,924 women planning a home birth at the onset of labor, 94% had a vaginal birth, and fewer than 5% required oxytocin augmentation or epidural analgesia.
- ✦ Eleven percent of women who went into labor intending to give birth at home transferred to the hospital during labor; failure to progress was the primary reason for intrapartum transfer.
- ✦ Nearly 1100 women attempted a vaginal birth after cesarean (VBAC) in this sample, with a total VBAC success rate of 87%.
- ✦ Rates of cesarean, low 5-minute Apgar score (< 7), intact perineum, breastfeeding, and intrapartum and early neonatal mortality for this sample are all consistent with reported outcomes from the best available population-based, observational studies of planned home births.

after birth, or rates of neonatal intensive care unit (NICU) admissions.

The second study, a prospective, 5-year (2000-2004) matched cohort study in British Columbia, compared outcomes for low-risk women in a midwife-attended planned home birth group (n = 2889), a physician-attended hospital birth group (n = 5331), and a midwife-attended planned hospital birth group (n = 4752).[11] In this intention-to-treat analysis, women in the planned home birth group had significantly fewer intrapartum interventions, including narcotic or epidural analgesia, augmentation or induction of labor, and assisted vaginal or caesarean birth—as well as significantly fewer adverse outcomes, including postpartum hemorrhage, and third- or fourth-degree lacerations. No significant differences were found between the home birth group and either comparison group with respect to the diagnosis of asphyxia at birth, seizures, need for assisted ventilation beyond the first 24 hours of life, or low 5-minute Apgar scores (< 7).

The third study analyzed data from the Ontario Ministry of Health Midwifery Program database to compare outcomes of all women planning home births between 2003 and 2006 (n = 6692) with a matched sample of women planning a hospital birth (n = 6692).[12] The primary outcome reported was a composite measure of perinatal and neonatal mortality or serious morbidity that included stillbirth or neonatal death at 0 to 27 days (excluding lethal anomalies), very low Apgar score (<4) at 5 minutes, neonatal resuscitation requiring both positive pressure ventilations and cardiac compressions, birth weight less than 2500 g, or admission to a neonatal or pediatric intensive care unit with a length of stay greater than 4 days. No differences were found between groups for perinatal and neonatal composite outcome measures (2.4% vs 2.8%; relative risk [RR] 0.84; 95% confidence interval [CI], 0.68-1.03). All measures of maternal morbidity were lower in the planned home birth group, as were rates for all obstetric interventions including cesarean (5.2% vs 8.1%; RR 0.64; 95% CI, 0.56-0.73).

Subsequently, in 2011 the Birthplace in England Collaborative Group reported findings from a prospective study of 64,538 births among low-risk women in England.[2,13] Investigators concluded that for healthy women, adverse maternal and newborn outcomes were extremely rare, regardless of birth setting. Planned home birth was associated with significantly fewer interventions, higher maternal satisfaction, and increased cost-effectiveness compared to birth in a hospital obstetric unit.[13] Most recently, Stapleton and colleagues[14] described outcomes from births attended by certified nurse-midwives (CNMs), licensed midwives (LMs), and CPMs that occurred in birth centers in the United States. These data were collected through the Uniform Data Set (UDS), a Web-based tool developed by the American Association of Birth Centers (AABC) for use in member centers. This National Birth Center Study II reported excellent outcomes and reduced interventions as a result of midwifery-led care in birth centers.

Olsen and Clausen,[15] in their 2012 Cochrane systematic review, suggest that while evidence from randomized controlled trials sufficiently powered to assess differences in perinatal mortality by birth site may never be available, the balance of evidence from large well-designed observational studies supports informed choice of birth place in jurisdictions where integrated maternity systems exist. However, some have suggested that these outcomes are not generalizable to the United States because there currently is no integrated maternity care system with clear communication between birth settings and across provider types.[16,17] Rising rates of home and birth center births, in the absence of a unified, national policy on choice and interprofessional collaboration across birth settings, are a major concern.[18] In addition, without established systems for universal maternity care data collection, it is difficult to evaluate the quality and safety of care across birth settings and by multiple provider types. The establishment of reliable and inclusive tools for US-based perinatal data collection has become a priority.

METHODS

Data Collection

Data were collected between 2004 and 2009 using the MANA Stats 2.0 Web-based data collection tool, which was developed by the MANA Division of Research in 2004 in accordance with the Agency for Healthcare Research and Quality guidelines.[19] Participation in the project was voluntary, with an estimated 20% to 30% of active CPMs and a substantially lower proportion of CNMs contributing.[5] Midwife participants obtained written informed consent from all clients at the onset of care, and only data from women who consented were included in the research dataset. More than 95% of women consented to be included,[5] a high rate of participation that has been observed in other studies involving this population.[4,14] All analyses presented here were approved by the institutional review board at Oregon State University.

The MANA Stats 2.0 online form collected data on nearly 200 variables, including demographic characteristics of participating women and families; pregnancy history as well as general health and social histories; antepartum, intrapartum, neonatal, and postpartum events and procedures; and maternal and newborn outcomes. Data were also collected on antepartum, intrapartum, and postpartum maternal and neonatal transfers, as well as on intended and actual place of birth. The data collection design for MANA Stats includes preregistration, or prospective logging, of all clients at the start of care, before outcomes are known. Midwife contributors complete the Web-based form over the course of care through the 6-week postpartum visit, or the final visit if earlier. Data are stored on a secure server with encryption software congruent with privacy and security measures for protected health information, as defined by the United States Department of Health and Human Services.[20,21] Upon enrollment in the project, midwife contributors are provided with detailed instructions on the use of the online data collection tool; and data collection support team members, known as data doulas, provide e-mail and phone support to all contributors.

All courses of care reported here were submitted by midwives using the 2.0 form. These records were subjected to 3 postsubmission review processes, described in detail elsewhere.[5] All data forms indicating maternal, fetal, or newborn deaths also underwent detailed case review using a modified fetal-infant mortality review approach.[22,23] Analysis of pre- and postreviewed variables during quality testing evidenced near perfect agreement, suggesting that MANA Stats 2.0 data were entered with a high degree of accuracy by midwives.[5] Thus, any errors in the dataset are likely random rather than systematic. For a detailed analysis of the history, methodology, and validity of the MANA Stats 2.0 data collection tool, see Cheyney et al.[5]

Inclusion Criteria

The complete November 2004 through December 2009 MANA Stats 2.0 dataset (N = 24,848) includes records from all women receiving at least some prenatal care from contributor midwives. For the purposes of this analysis, we excluded women who transferred care to another provider prior to the onset of labor, women who at the onset of labor had a planned birth location other than home, and women who did not live in the United States. Thus, our final sample for this analysis consisted of all planned home births (N = 16,924).

Data Export and Analysis

All data from the 2.0 dataset were exported from the structured query language-based online data collection system as a comma-separated value (*.csv) file and then imported into SPSS Statistics[24] for analysis. Our main analyses, in keeping with the descriptive objective of this study, consisted of calculating basic frequencies, measures of central tendency, measures of variance, and confidence intervals as indicated.

Throughout the analyses, we were careful to limit the denominators to those women and newborns at risk for the outcome. For instance, for all demographic characteristics, obstetric history, and pregnancy complication data, as well as the intrapartum transfers, the denominator is women who went into labor intending to give birth at home. For most perinatal outcomes, the denominator is newborns—removing those no longer at risk. For instance, the denominator for low Apgar score (< 7) is liveborn newborns. There are 2 exceptions: neonatal transfers and postpartum transfers are reported among the entire sample of neonates/women, as well as among only those who gave birth at home, thus excluding intrapartum transfers. The second method is technically correct. Mother–newborn dyads transferred during the intrapartum period are not at risk of postpartum or neonatal transfer. However, because the reporting of these variables is not consistent in the literature,[14,25] we report both values to allow for comparison with as many other studies as possible. In addition, in keeping with standards for reporting results from observational studies,[26] we have included the actual denominators (ie, the theoretical denominator of women, or liveborn newborns, minus participants missing data for that variable) as well as 95% CIs, as relevant.

RESULTS

Contributing Midwives

Data were contributed by 432 different midwives, including CPMs/LMs/LDMs, CNMs/CMs, naturopathic midwives, unlicensed direct-entry midwives, and others (Table 1). The majority of births in the sample were attended by CPMs (79.2%).

Demographic Characteristics

The final sample included 16,924 women and 16,984 newborns (Figure 1). Complete demographic characteristics for the sample are reported in Table 2. Briefly, most women in this sample were white, college-educated, and married. Of note, greater than 6% of the sample was identified by their midwife as Amish or Mennonite. Although midwives in all states are eligible to contribute data to MANA Stats, the 2.0 home birth cohort comes disproportionately from the Western United States. Almost two-thirds of the women in this sample paid for midwifery care out-of-pocket, either because their insurance did not cover home birth, their midwife did not provide insurance billing, or because they were uninsured.

Antenatal Risk Status

Antenatal risk profiles of the women are presented in Table 2. Twenty-two percent of the sample was nulliparous, and 9.2% of multiparous women were grand multiparas (≥ 5 previous births after 20 weeks' gestation). Of the parous women, 8.0% had a history of previous cesarean. Most women began their pregnancies with a normal (18.5-25 kg/m^2) body mass index (BMI).

Very few of the pregnancies in our sample were complicated by maternal comorbidities, including hypertensive

Table 1. Midwife Credentials and Number of Births Attended for 16,984 Planned Home Births

Category	Number of Midwives With This Credential	Total Number of Births Attended by This Type of Midwife	Median (range) Number of Births Contributed by Individual Midwives of This Type During the Entire 62-month Study Period
CPM/LM/LDM	320	13,400	239 (4-880)
CNM/CM	44	1595	457 (108-800)
Both[a] CPM and CNM	16	1018	260 (7-721)
Neither[b]	52	971	287 (18-884)

Abbreviations: CM, certified midwife; CNM, certified nurse-midwife; CPM, certified professional midwife; LDM, licensed direct-entry midwife; LM, licensed midwife.
[a]These 16 practitioners held both a CPM and CNM credential.
[b]Neither a CPM, LM, LDM, CNM, and/or CM. This category includes direct-entry midwives without licensure or certification; "other" providers, which is a heterogeneous category containing students, naturopathic doctors, and doctors of osteopathy; and "missing," where the credential is unknown.

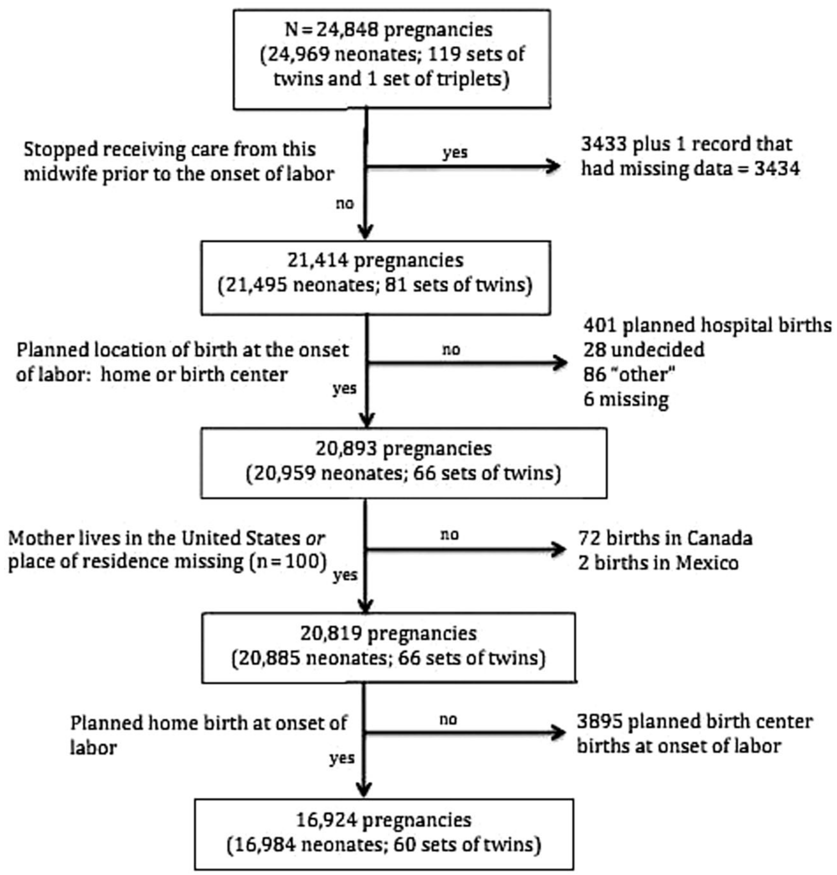

Figure 1. Sample Size Delimitation
Delimitation begins with all records entered into the Midwives Alliance of North America Statistics Project (MANA Stats) using the 2.0 data form (birth years 2004- 2009). Final analyses are limited to women who planned home birth at onset of labor (N = 16,924).

disorders, gestational diabetes mellitus (GDM), persistent anemia (defined as hematocrit <30 or hemoglobin <10 g/dL), or Rh sensitization. Because the 2.0 version form was not designed to collect data on collaborative care, it is impossible to determine exactly when these complications developed or how many women were co-managed with a physician. Of the 168 women with GDM, preeclampsia, eclampsia, or Rh sensitization, 74 had at least one prenatal visit with an obstetrician, and 47 had at least 3 prenatal visits with an obstetrician (an additional 33 women did not have data on obstetrician visits). In addition, of the 50 women with multiple gestations who had complete data on visits with other providers, 22 saw an obstetrician prenatally at least once, and 13 saw an obstetrician at least 3 times.

Mode of Birth

The spontaneous vaginal birth rate for the sample was 93.6%. The rate of vacuum or forceps-assisted vaginal birth was 1.2%. The overall cesarean rate was 5.2%, and most of these were primary cesareans (84.4%). Our sample included 1054 women with a history of cesarean, and these women had a vaginal

Table 2. Demographic Characteristics, Obstetric History, and Pregnancy Complications for 16,924 Women in the MANA Stats 2.0 Sample who Planned Home Births

Characteristics	
Race/Ethnicity,[a,b] n (%)	
White	15,614 (92.3)
Black	361 (2.1)
Latina	714 (4.2)
Asian/Pacific Islander	760 (4.5)
Native American	163 (1.0)
Other	145 (0.9)
Belongs to Amish, Mennonite, or other Plain church, n (%)	1098 (6.5)
Age at first prenatal visit, mean (SD), y	30.3 (5.3)
Education, n (%)	
High school graduate[c]	15,283 (92.4)
Completed ≥ 4 years of college[d]	8300 (58.0)
Marital status,[e] n (%)	
Married	14,961 (88.4)
Unmarried with a partner	1579 (9.3)
Single (includes separated, divorced)	331 (2.0)
Other	51 (0.3)
MANA region of residence,[f] n (%)	
Region 1: New England (CT, MA, ME, NH, RI, VT)	873 (5.2)
Region 2: North Atlantic (DC, DE, NJ, NY, MD, PA)	1992 (11.8)
Region 3: Southeast (AL, AR, FL, GA, LA, MS, NC, KY, SC, TN, VA, WV)	2054 (12.2)
Region 4: Midwest (IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI)	2646 (15.6)
Region 5: West (AZ, CO, ID, MT, NM, NV, OK, TX, UT, WY)	3949 (23.4)
Region 6: Pacific (AK, CA, HI, OR, WA)	5364 (31.8)
Method of payment,[g] n (%)	
Self-pay (does not necessarily mean uninsured)	10,888 (64.4)
Private insurance	4092 (24.2)
Government insurance (includes Medicaid, CHAMPUS)	1361 (8.0)
Other	576 (3.4)
Parity, n (%)	
Nulliparous	3773 (22.3)
Multiparous	13,150 (77.7)
Grand multiparous (≥ 5 pregnancies)[h]	1150 (9.2)
Trial of labor after cesarean[i]	1052 (8.0)
Normal BMI prepregnancy,[j] n (%)	11,144 (66.9)
Mother's pregravid BMI (kg/m^2),[k] median (IQR)	22.5 (20.6-25.7)
Complications/comorbid conditions affecting this pregnancy,[l] n (%)	
Chronic hypertension	59 (0.3)
Pregnancy-induced hypertension	243 (1.4)
Preeclampsia	29 (0.2)
Eclampsia	10 (0.1)
Gestational diabetes mellitus	132 (0.8)
Persistent anemia	146 (0.9)
Rh sensitization	41 (0.2)
Multiple gestation, n (%)	60 (0.4)
Breech presentation,[m] n (%)	222 (1.3)

Continued

Abbreviations: BMI, body mass index; CHAMPUS, Civilian Health and Medical Program of the Uniformed Services; IQR, interquartile range; MANA, Midwives Alliance of North America; SD, standard deviation.
[a]Midwife identified, categories are not mutually exclusive.
[b]Missing data for 14 women.
[c]Missing data for 390 women.
[d]Missing data for 970 women.
[e]Missing data for 2 women.
[f]Missing data for 46 women.
[g]Missing data for 7 women.
[h]Missing data for 606 women; percent calculated using multiparous women as the denominator.
[i]Missing data for 6 women.
[j]Missing data for 273 women.
[k]Missing data for 273 women.
[l]Missing data for one woman.
[m]Denominator is 16,984 neonates.

birth after cesarean (VBAC) success rate of 87.0%. Of the 915 successful VBACs, 94% were completed at home. A total of 222 newborns in a breech presentation were born vaginally (57.2%) or by cesarean (42.8%) (Table 3). Of the 127 breech neonates born vaginally, 92% were born at home.

Gestational Age and Birth Weight

Ninety-two percent of newborns were full-term, 2.5% were preterm, and 5.1% were postterm based on the midwife's clinical gestational age assessment following birth. The sample mean (SD) for live birth weight was 3651 g (488 g). The median birth weight was 3629 g (interquartile range, 3317 g-3969 g). Fewer than 1% of newborns were low birth weight (<2500 g), although almost one-quarter were macrosomic (> 4000 g) (Table 3).

Transfers

Intrapartum Transfers

Of the 16,924 women who began labor at home, 89.1% completed a home birth for an intrapartum transfer rate of 10.9%. Nulliparous women required transfer during labor 3 times as frequently as multiparous women (Table 4). The most common reason for transfer was failure to progress (n = 752, 40.7% of intrapartum transfers). Other reported reasons for

Table 3. Birth Outcomes for 16,984 Neonates with Planned Home Births in the MANA Stats 2.0 Sample

Outcome	n (%)
Mode of Birth[a]	
Spontaneous vaginal	15,876 (93.6)
Assisted vaginal (166 vacuum, 35 forceps)	201 (1.2)
Cesarean	887 (5.2)
If cesarean, was this birth a primary cesarean?[b]	
Yes	743 (84.4)
No	137 (15.6)
If this birth included a TOLAC, did mother have a vaginal birth?	
Yes	915 (87.0)
No	137 (13)
Breech presentation	
Vaginal birth	127 (57.2)
Cesarean	95 (42.8)
Gestational age of neonate[c]	
Preterm[d]	423 (2.5)
Postterm[e]	862 (5.1)
Birth weight[f]	
Low birth weight (<2500 g)	142 (0.8)
Macrosomic (> 4000g)	3817 (22.6)
5-minute Apgar score <7[g]	245 (1.5)
Any NICU admissions in the first 6 weeks[h]	479 (2.8)

Abbreviations: MANA, Midwives Alliance of North America; NICU, neonatal intensive care unit; TOLAC, trial of labor after cesarean.
[a]Missing data for 20 women.
[b]Missing data for 7 women.
[c]These data come from 2 questions on the 2.0 data entry form. The exact wording of the questions are: "Any clinical evidence that baby is preterm?" and "Any clinical evidence that baby is postterm?" Further instructions were not given to midwives.
[d]Missing data for 33 neonates.
[e]Missing data for 43 neonates.
[f]Missing data for 66 neonates.
[g]Missing data for 401 neonates.
[h]Missing data for 130 neonates.

intrapartum transfer included desire for pain relief (n = 281, 15.2%), fetal distress or meconium (n = 185, 10.0%), malpresentation (n = 118, 6.4%), and maternal exhaustion (n = 98, 5.3%). When entering data, midwives could select more than one reason. Of the 1856 women who transferred to the hospital during labor, more than half gave birth vaginally (Table 4).

Postpartum Maternal Transfers

Postpartum maternal transfer occurred for 1.5% of women who went into labor intending to give birth at home and occurred for 1.7% of women who gave birth at home. Of the 251 women who were transferred after giving birth at home, 177 (70.5%) were transferred for complications related to hemorrhage and/or retained placenta, and 41 (16.3%) were transferred for a laceration repair. The remaining postpartum transfers were for a variety of reasons including abnormal maternal vital signs, hematoma, unassisted precipitous labor

Table 4. Intrapartum, Postpartum Maternal, and Neonatal Transfers with Key Outcomes Following Transfer[a]

Variable	n (%)	(95% CI)
Intrapartum transfer[b]	1850 (10.9)	(10.4-11.4)
Primiparous women (n = 3770)	864 (22.9)	(21.6-24.2)
Multiparous women (n = 13,143)	986 (7.5)	(7.0-8.0)
If intrapartum transfer		
Epidural analgesia[c]	1028 (56.1)	(53.8-58.4)
Oxytocin augmentation[d]	408 (22.0)	(20.1-23.9)
Vaginal birth[e]	984 (53.2)	(50.9-55.5)
5-minute Apgar score < 7[f]	69 (4.5)	(3.5-5.5)
NICU admission in the first 6 weeks[g]	167 (9.5)	(8.1-10.9)
Postpartum maternal transfer[h]	251 (1.5)	(1.3-1.7)
Neonatal transfer[i]	149 (0.9)	(0.7-1.1)
If neonatal transfer		
5-minute Apgar score < 7	66 (44.3)	(36.3-52.3)
NICU admission in the first 6 weeks[j]	109 (75.2)	(68.2-82.2)

Abbreviations: CI, confidence interval; NICU, neonatal intensive care unit.
[a]Denominators are 16,984 neonates or 16,924 mothers, unless otherwise indicated. Proportions are calculated for postpartum maternal and neonatal transfers using the entire sample (less missing) for the denominator, rather than limiting to mother/newborn dyads still at risk for transfer after birth, in order to be consistent with other literature in this field.
[b]Missing data for 11 women.
[c]Missing data for 18 women.
[d]Missing data for 1 woman.
[e]Missing data for 1 woman.
[f]Missing data for 329 women.
[g]Missing data for 93 women.
[h]Missing data for 91 women.
[i]Missing data for 128 newborns.
[j]Missing data for 4 neonates.

when parents called emergency medical services, or mother unable to void.

Neonatal Transfers

Neonatal transfer occurred for 0.9% (149/16,984) of all newborns whose mothers went into labor intending to give birth at home and occurred for 1.0% (149/15,134) of the newborns born at home. The majority of these 149 newborn transfers were for respiratory distress and/or Apgar scores below 7 (n = 116, 77.9%); an additional 9 newborns (6.0%) were transferred for evaluation of congenital anomalies.

Maternal Morbidity and Mortality

Of the 16,039 women who gave birth vaginally, 49.2% did so over an intact perineum; 1.4% had an episiotomy; 40.9% sustained a first- or second-degree perineal laceration; and 1.2% had a third- or fourth-degree perineal laceration. Labial lacerations or skin splits that did not require suturing occurred in 12.8% of the women, and 4.8% had more substantial labial lacerations that required suturing. Midwives could indicate more than one type or location of laceration. Of women who gave birth vaginally, 15.5% (n = 2426) lost greater than 500 mL of blood following birth, and 4.8% (n = 318) lost 1000 mL or greater. Of the women who lost greater than 500 mL of blood after a vaginal birth, 51.4% were given oxytocin (n = 797), methergine (n = 132), or both (n = 317) to control bleeding.

There was one pregnancy-related maternal death in the sample. This multiparous mother had no antenatal or intrapartum risk factors. The newborn was born vaginally at home with Apgar scores of 8 and 9 at 5 and 10 minutes, respectively, and the postpartum course for mother and newborn was normal through the first 3 postpartum days. Death occurred at the mother's home on the third day postpartum in the afternoon, following a morning visit by the midwife during which all vital signs had been normal. A blood clot was found in the mother's heart during autopsy; the death was attributed to the pregnancy by the medical examiner.

Fetal and Neonatal Morbidity and Mortality

For all newborns in the sample (including those with congenital anomalies and regardless of actual location of birth), 1.5% (n = 245) had 5-minute Apgar scores below 7, and 0.6% (n = 97) had Apgar scores below 4. Of the 1850 newborns born in the hospital following an intrapartum transfer, 3.7% (n = 69) had a 5-minute Apgar score below 7. During the first 6 weeks postpartum, 479 (2.8%) newborns were admitted to the NICU (Tables 3 and 4).

The rate of intrapartum fetal death (occurring after the onset of labor, but prior to birth) was 1.30 per 1000. The rate of early neonatal death (death occurring after a live birth, but before 7 completed days of life) was 0.88 per 1000; and the rate of late neonatal death (death occurring at 7 to 27 completed days of life) was 0.41 per 1000. When lethal congenital anomaly-related deaths were excluded (n = 0 intrapartum, n = 8 early neonatal, n = 1 late neonatal), the rates of intrapartum death, early neonatal death, and late neonatal death were 1.30 per 1000 (n = 22), 0.41 per 1000 (n = 7), and 0.35 per 1000 (n = 6), respectively (Table 5).

Of the 22 fetuses who died after the onset of labor but prior to birth, 2 were attributed to intrauterine infections, 2 were attributed to placental abruption, 3 were attributed to cord accidents, 2 were attributed to complications from maternal GDM, one was attributed to meconium aspiration, one was attributed secondary to shoulder dystocia, one was attributed to preeclampsia-related complications, and one was attributed to autopsy-confirmed liver rupture and hypoxia. The causes of the remaining 9 intrapartum deaths were unknown. For the 7 newborns who died during the early neonatal period, 2 were secondary to cord accidents during birth (one with shoulder dystocia), and the remaining 5 were attributed to hypoxia or ischemia of unknown origin. Of the 6 newborns that died in the late neonatal period, 2 were secondary to cord accidents during birth, and the causes of the remaining 4 deaths were unknown.

When examining perinatal death rates among higher-risk women, the data suggest that compared to neonates born in vertex presentation, neonates born in breech presentations were at increased risk of intrapartum death (1.09/1000 vertex vs 13.51/1000 breech, $P < 0.01$), early neonatal death (0.36/1000 vertex vs 4.57/1000 breech, $P = 0.09$), and late neonatal death (0.30/1000 vertex vs 4.59/1000 breech, $P = 0.08$). In this sample, primiparous women were at increased risk of having an intrapartum fetal death compared to multiparous women (2.92/1000 primiparous vs 0.84/1000 multiparous, $P < 0.01$). Newborns born to primiparas were not, however, at increased risk of either early or late neonatal death. The same pattern was seen for multiparous women with a history of cesarean undergoing a trial of labor after cesarean (TOLAC): an increased risk of intrapartum fetal death, when compared to multiparous women with no prior cesarean (2.85/1000 TOLAC vs 0.66/1000 multiparas without a history of cesarean, $P = 0.05$; Table 5), but no increase in neonatal death. There was no evidence of increased risk of death among multiple births. When higher-risk women (those with multiple gestations, breech presentation, TOLAC, GDM, or preeclampsia) were removed from the sample, the intrapartum death rate was 0.85 per 1000 (95% CI, 0.39-1.31).

Breastfeeding

At 6 weeks postpartum, 97.7% (n = 16,338) of newborns were at least partially breastfed. Only 0.4% (n = 70) were never breastfed, and 86.0% (n = 14,344) were exclusively breastfed through at least 6 weeks postpartum.

DISCUSSION

In this large national sample of midwife-led, planned home births in the United States, the majority of women and newborns experienced excellent outcomes and very low rates of intervention relative to other national datasets of US women.[27–29] Rates of spontaneous vaginal birth, cesarean, low 5-minute Apgar score (<7), intact perineum, breastfeeding, and intrapartum and early neonatal mortality are all consistent with reported outcomes from the best available population-based observational studies of planned home and birth center births.[2,10–12,14,30] Rates of successful VBAC are higher than reported elsewhere (87% vs 60-80%),[31–33] with no significant increase in early or overall neonatal mortality. There is some evidence of increased intrapartum fetal death associated with TOLAC; however, the total number of events was too low for reliable analysis. Only 4.5% of the total MANA Stats sample required oxytocin augmentation and/or epidural analgesia, which is notably lower than rates of these interventions reported more broadly in the United States (26% for oxytocin augmentation and 67% for epidural analgesia).[27] Rates of operative vaginal birth and cesarean are also substantially lower than those reported for hospital-based US samples (1.2% vs 3.5% and 5.2% vs 32.8%, respectively).[27,29,34] Such reduced rates of obstetric procedures and interventions may result in significant cost savings and increased health benefits for low-risk women who give birth outside of the hospital.[13,35] In addition, fewer than 5% of the newborns born in the hospital after an intrapartum transfer had a 5-minute Apgar score below 7, and 2.1% had a score below 4, indicating relatively low morbidity even among the transferred subsample. These findings are consistent with outcomes reported in the National Birth Center Study II.[14]

The reported rate of postpartum hemorrhage (>500 mL for vaginal births) is higher in this sample relative to the rates reported by others (15.4% vs 1.4%-3.7%).[36–38] However, only 51.4% of women with postpartum hemorrhage received an antihemorrhagic agent. In addition, the frequency of

Table 5. Death Rates for the Entire Sample and for Selected Subgroups[a] Excluding Lethal Congenital Anomalies

	Intrapartum				Early Neonatal				Late Neonatal			
	Deaths	Denominator	Rate/1000 (95% CI)	P Value[b]	Deaths	Denominator	Rate/1000 (95% CI)	P Value[b]	Deaths	Denominator	Rate/1000 (95% CI)	P Value[b]
Overall	22	16,980	1.30 (0.75-1.84)		7	16,950	0.41 (0.11-0.72)		6	16,942	0.35 (0.07-0.64)	
Presentation												
Vertex	18	16,575	1.09 (0.58-1.59)	0.003	6	16,549	0.36 (0.07-0.65)	0.088	5	16,542	0.30 (0.04-0.57)	0.076
Breech	3	222	13.51 (0-28.70)		1	219	4.57 (0-13.50)		1	218	4.59 (0-13.56)	
Parity												
Multiparous	11	13,146	0.84 (0.34-1.33)	0.004	6	13,132	0.27 (0-0.79)	1.0	3	13,126	0.23 (0-0.49)	0.13
Primiparous	11	3773	2.92 (1.20-4.64)		1	3757	0.46 (0.09-0.82)		3	3755	0.80 (0-1.70)	
Trial of Labor After Cesarean[c]												
No	8	12,088	0.66 (0.20-1.12)	0.052	5	12,077	0.41 (0.05-0.78)	0.39	2	12,072	0.17 (0-0.40)	0.22
Yes	3	1052	2.85 (0-6.07)		1	1049	0.95 (0-2.82)		1	1048	0.95 (0-2.82)	
Multiple Gestation												
Singleton	21	16,914	1.24 (0.71-1.77)	0.14	7	16,831	0.42 (0.11-0.72)	–[d]	6	16,823	0.36 (0.07-0.64)	–
Twins	1	120	8.33 (0-24.6)		0	119	–		0	119	–	
Gestational Diabetes Mellitus												
No	20	16,787	1.19 (0.67-1.71)	0.013	7	16,759	0.42 (0.11-0.73)	–	6	16,751	0.36 (0.07-0.64)	–
Yes	2	132	15.15 (0-35.99)		0	130	–		0	130	–	
Preeclampsia												
No	21	16,880	1.24 (0.71-1.77)	0.037	7	16,862	0.42 (0.11-0.72)	–	6	16,854	0.36 (0.07-0.64)	–
Yes	1	29	34.48 (0-100.89)		0	27[e]	–		0	27	–	

Abbreviations: CI, confidence interval.
[a]There are 4 singleton pregnancies, 3 of which were breech presentations, for which all birth outcomes data are unavailable. These women began labor at home and then transferred to the hospital prior to birth. The midwives of record were contacted, and in each case the midwife did not accompany the mother, nor did the mother return to the midwife for postpartum care.
[b]Fisher's exact test.
[c]Among parous women only.
[d]Dashes indicate value cannot be calculated because there were no events in this subgroup.
[e]One newborn of a mother with preeclampsia died during the early neonatal period of a lethal congenital anomaly and was therefore excluded from all calculations for the neonatal period.

postpartum maternal transfer for excessive bleeding was low overall, suggesting that midwife contributors to MANA Stats did not deem all cases of blood loss greater than 500 mL to require pharmacologic intervention or transfer. We interpret these findings in 2 ways. First, we suspect that the MANA Stats rates for postpartum hemorrhage may be unreliable because they are dependent on visual estimation of blood loss, which has been shown to be highly inaccurate across provider types and birth setting.[39,40] Second, because active management of third stage is less frequent in this sample, and because so few of the women in MANA Stats had intravenous oxytocin administered at the time of birth, our findings call into question, as have other studies,[36,41–43] whether 500 mL is an appropriate benchmark for the diagnosis of postpartum hemorrhage in a physiologic birth population.

It is difficult to compare birth-related mortality statistics across studies; there are so few death outcomes that statistical power is quite low. This is not unexpected: The intrapartum, maternal, and neonatal death rates in high-resource countries are remarkably low overall. The lack of power is further compounded in studies of planned home and birth center births because cohorts from these birth locations are commonly comprised of relatively low-risk women, thus fewer deaths are expected. Furthermore, when examining the home and birth center birth literature to date, there is little consistency in the way that mortality data are defined and reported, and few authors provide confidence intervals or sufficient raw data to allow for comparison. Nonetheless, it is useful to compare death rates associated with planned home and birth center births, as reported across a variety of geographic settings (although confidence intervals around the rates are large) because any potential differences observed can serve to generate hypotheses for future work.

The intrapartum fetal death rate among women planning a home birth in our sample was 1.3 per 1000 (95% CI, 0.75-1.84). This observed rate and CI are statistically congruent with rates reported by Johnson and Daviss[4] and Kennare et al[30] but are higher than the intrapartum death rates reported by de Jonge et al,[10] Hutton et al,[12] and Stapleton et al.[14] While the absolute risk[44] is still quite low, the relatively elevated intrapartum mortality rate in our sample may be partially a function of the higher risk profile of the MANA Stats sample relative to de Jonge et al,[10] Hutton et al,[12] and Stapleton et al[14] whose samples contain primarily low-risk, singleton, vertex births. When women who are at higher risk for adverse outcomes (ie, women with multiple gestations, breech presentation, TOLAC, GDM, or preeclampsia) are removed from our sample, the intrapartum death rate (0.85 per 1000; 95% CI, 0.39-1.31) is statistically congruent with rates reported by Hutton et al[12] and Stapleton et al,[14] although still higher than that reported by de Jonge et al.[10] It is also possible that the unique health care system found in the United States—and particularly the lack of integration across birth settings, combined with elevated rates of obstetric intervention—contributes to intrapartum mortality due to delays in timely transfer related to fear of reprisal and/or because some women with higher-risk pregnancies still choose home birth because there are fewer options that support normal physiologic birth available in their local hospitals.[18,30,45–48]

The early neonatal death rate in our home birth sample was 0.41 per 1000, which is statistically congruent with rates reported by de Jonge et al[10] and the Birthplace in England Collaborative Group.[2] Our combined early and late neonatal death rates, or total neonatal death rate, of 0.77 per 1000 is statistically congruent with the rate reported by Hutton et al.[12] Other studies of planned home or planned birth center birth either define neonatal mortality differently or do not define it at all, making comparisons difficult. In addition, some of the intrapartum fetal deaths, as well as some additional neonatal deaths, reported in MANA Stats may have been congenital anomaly-related. There were several incidences when the midwife or receiving physician suspected congenital defect based on visual assessment, but an autopsy or other testing was declined and no official cause of death was assigned. The number of unknown causes of death in our sample is also at least partially attributable to parents declining autopsies[49]; of the 35 intrapartum and neonatal deaths not attributed to congenital anomaly, only 6 received an autopsy.

Collectively, our findings are consistent with the body of literature that shows that for healthy, low-risk women, a planned home birth attended by a midwife can result in positive outcomes and benefits for both mother and newborn. However, the safety of home birth for higher-risk pregnancies, particularly with regard to breech presentation (5 fetal/neonatal deaths in 222 breech presentations), TOLAC (5 out of 1052), multiple gestation (one out of 120), and maternal pregnancy-induced comorbidities (GDM: 2 out of 131; preeclampsia: one out of 28) requires closer examination because the small number of events in any one subgroup limited the effective sample size to the point that multivariable analyses to explore these associations further were not possible. It is unclear whether the increased mortality associated with higher-risk women who plan home births is causally linked to birth setting or is simply consistent with the expected increase in rates of adverse outcomes associated with these complications.

Limitations

The main limitation of this study is that the sample is not population-based. There is currently no mandatory, reliable data collection system designed to capture and describe outcomes for all planned home births in the United States. We are also unable, for a number of reasons detailed elsewhere,[5] to quantify precisely what proportion of practicing midwives of various credentials contributed data to MANA Stats between 2004 and 2009. In addition, the data entered into the MANA Stats system come from medical records. Because medical records are kept primarily for patient care purposes with secondary uses for billing, research, and legal documentation, researchers using data derived from medical records must be cognizant of these limitations.[50–53] However, we expect that the outcomes reported here were likely to be recorded in the medical record with a reasonably high degree of accuracy because of their importance to clinical care. Furthermore, our pre-/postdata review analysis indicated that data were initially entered with a high degree of accuracy.[5] Finally, we cannot confirm with 100% certainty that participating midwives entered data from all of their clients. However, because the

MANA Stats system requires that clients be logged early in prenatal care, any such exclusions would have occurred prior to the outcome of the birth being known.[5]

CONCLUSION

Descriptive data from the first 6 years (2004-2009) of the MANA Statistics Project demonstrate that for this large, national cohort of women who planned home births under the care of a midwife, perinatal outcomes are congruent with the best available data from population-based observational studies that have evaluated outcomes by intended place of birth and by pregnancy risk profiles. Low-risk women in this sample experienced high rates of normal physiologic birth and very low rates of operative birth and interventions, with no concomitant increase in adverse events. Conclusions are less clear for higher-risk women. Given the low absolute number of events and the lack of a matched comparison group, we were unable to discern whether poorer outcomes among higher-risk women were associated with place of birth or related to risks inherent to their conditions.

Prospective cohort studies with matched comparison groups that utilize the large datasets collected by MANA Stats and AABC's UDS have the potential to address critical gaps in our understanding of birth settings and providers in the United States. We recommend that future research focus on 3 critical questions: 1) What place of birth is most likely to lead to optimal maternal and newborn health, given specific risk profiles and regionally available birth options? 2) What are the characteristics of midwife-led care that contribute to safe physiologic birth? and 3) Regardless of where a woman chooses to give birth, how can clinicians most effectively collaborate across birth settings and provider types to achieve the best possible outcomes for women and newborns?

AUTHORS

Melissa Cheyney, PhD, CPM, LDM, is an Associate Professor of medical anthropology and reproductive biology in the Department of Anthropology at Oregon State University in Corvallis, Oregon. She is also a certified professional midwife, licensed in the State of Oregon, and the Chair of the Division of Research for the Midwives Alliance of North America (MANA).

Marit Bovbjerg, PhD, MS, is a Research Associate (postdoctoral) in the College of Public Health and Human Sciences at Oregon State University in Corvallis, Oregon. She is also the Director of Data Quality for the MANA Division of Research.

Courtney Everson, MA, is a Doctoral Candidate in medical anthropology in the Department of Anthropology at Oregon State University in Corvallis, Oregon. She is also the Director of Research Education for the MANA Division of Research and faculty at the Midwives College of Utah.

Wendy Gordon, MPH, CPM, LM, is a midwife and Assistant Professor in the Department of Midwifery at Bastyr University in Seattle, Washington. She is also a board member and Director of Equity Initiatives for the Association of Midwifery Educators.

Darcy Hannibal, PhD, is a primatologist conducting research on welfare improvement for the Behavioral Management Program at the California National Primate Research Center at the University of California (UC) Davis. She is also Laboratory Manager for the McCowan Animal Behavior Laboratory for Welfare and Conservation in the Department of Population Health and Reproduction at UC Davis.

Saraswathi Vedam, CNM, RM, MSN, FACNM, SciD(hc), is an Associate Professor in the Faculty of Medicine at the University of British Columbia. She serves as Senior Advisor to the MANA Division of Research and practices as a registered midwife in Vancouver, British Columbia.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

ACKNOWLEDGMENTS

We would like to thank Bruce Ackerman for his countless hours of volunteer work as Director of Data Collection; Ellen Harris-Braun for her tireless attention to detail as Director of Database Development; and Trinlie Wood, Contributor Enrollment and Consent Manager, for her seemingly endless dedication to the MANA Statistics Project. We would also like to acknowledge Peggy Garland for early leadership on the MANA Division of Research and Geradine Simkins for her longstanding support of this project. Their vision has helped bring the project to where it is today. The MANA Statistics Project has been generously funded by the Foundation for the Advancement of Midwifery, the Transforming Birth Fund, and the MANA Board of Directors. We are also grateful for the midwives and families who have contributed their time and data to the project over the last 9 years and to those who have contributed as dedicated volunteers.

REFERENCES

1. MacDorman M, Declercq E, Mathews TJ. Recent trends in out-of-hospital births in the United States. *J Midwifery Womens Health*. 2013;58(5):494-501.
2. Birthplace in England Collaborative Group, Brocklehurst P, Hardy P, Hollowell J, et al. Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: The Birthplace in England national prospective cohort study. *BMJ*. 2011;343:d7400.
3. Hendrix MJ, Evers SM, Basten MC, Nijhuis JG, Severens JL. Cost analysis of the Dutch obstetric system: Low-risk nulliparous women preferring home or short-stay hospital birth–a prospective non-randomised controlled study. *BMC Health Serv Res*. 2009;9:211.
4. Johnson KC, Daviss BA. Outcomes of planned home births with certified professional midwives: Large prospective study in North America. *BMJ*. 2005;330(7505):1416-1422.
5. Cheyney M, Bovbjerg M, Everson C, Gordon W, Hannibal D, Vedam S. Development and Validation of a National Data Registry for Midwife-Led Births: The Midwives Alliance of North America Statistics Project 2.0 Dataset. *J Midwifery Womens Health*. 2014;59(1):8-16.
6. Declercq E, Macdorman MF, Menacker F, Stotland N. Characteristics of planned and unplanned home births in 19 States. *Obstet Gynecol*. 2010;116(1):93-99.
7. MacDorman MF, Mathews TJ, Declercq E. Home births in the United States, 1990–2009. *NCHS Data Brief*. 2012;84:1-8.
8. Northam S, Knapp TR. The reliability and validity of birth certificates. *JOGNN NAACOG*. 2006;35(1):3-12.

9. Hendrix M, Van Horck M, Moreta D, et al. Why women do not accept randomisation for place of birth: Feasibility of a RCT in The Netherlands. *BJOG*. 2009;116(4):537-544.
10. De Jonge A, van der Goes BY, Ravelli ACJ, et al. Perinatal mortality and morbidity in a nationwide cohort of 529,688 low-risk planned home and hospital births. *BJOG*. 2009;116(9):1177-1184.
11. Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician. *CMAJ*. 2009;181(6–7):377-383.
12. Hutton EK, Reitsma AH, Kaufman K. Outcomes associated with planned home and planned hospital births in low-risk women attended by midwives in Ontario, Canada, 2003–2006: A retrospective cohort study. *Birth*. 2009;36(3):180-189.
13. Schroeder E, Petrou S, Patel N, et al. Cost effectiveness of alternative planned places of birth in woman at low risk of complications: Evidence from the Birthplace in England national prospective cohort study. *BMJ*. 2012;344:e2292.
14. Stapleton SR, Osborne C, Illuzzi J. Outcomes of care in birth centers: Demonstration of a durable model. *J Midwifery Womens Health*. 2013;58(1):3-14.
15. Olsen O, Clausen JA. Planned hospital birth versus planned home birth. *Cochrane Database Syst Rev Online*. 2012;9:CD000352. doi:10.1002/14651858.CD000352.pub2.
16. Wax JR, Lucas FL, Lamont M, Pinette MG, Cartin A, Blackstone J. Maternal and newborn outcomes in planned home birth vs planned hospital births: A metaanalysis. *Am J Obstet Gynecol*. 2010;203(3):243.e1-8.
17. ACOG Committee on Obstetric Practice. ACOG committee opinion No. 476: Planned home birth. *Obstet Gynecol*. 2011;117(2 Pt 1):425-428.
18. Cheyney M, Everson C, Burcher P. Homebirth transfers in the United States: Narratives of risk, fear, and mutual accommodation. *Qual Health Res*. In press.
19. Gliklich R, Dreyer N, eds. *Registries for Evaluating Patient Outcomes: A User's Guide*. 2nd ed. Rockville, MD: Agency for Healthcare Research and Quality (US); 2010.
20. The Security Rule. U.S. Department of Health and Human Services Web site. http://www.hhs.gov/ocr/privacy/hipaa/administrative/securityrule/index.html. Accessed February 14, 2013.
21. The Privacy Rule. U.S. Department of Health and Human Services Web site. http://www.hhs.gov/ocr/privacy/hipaa/administrative/privacyrule/index.html. Accessed February 14, 2013.
22. Women's and Children's Health Policy Center. *Fetal and Infant Mortality Review (FIMR) in Brief*. Baltimore, MD: John Hopkins University; 2002.
23. Grason H, Liao M. *Fetal and Infant Mortality Review (FIMR): A Strategy for Enhancing Community Efforts to Improve Perinatal Health*. Baltimore, MD: John Hopkins University; 2002.
24. IBM Corporation. *SPSS Statistics Version 20.0.0.0*. Armonk, NY: IBM Corporation; 2012.
25. Amelink-Verburg MP, Verloove-Vanhorick SP, Hakkenberg RMA, Veldhuijzen IME, Bennebroek Gravenhorst J, Buitendijk SE. Evaluation of 280,000 cases in Dutch midwifery practices: A descriptive study. *BJOG*. 2008;115(5):570-578.
26. Von Elm E, Altman DG, Egger M, et al. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. *J Clin Epidemiol*. 2008;61(4):344-349.
27. Declercq E, Sakala C, Corry M, Applebaum S, Herrlich A. *Listening to Mothers III: Pregnancy and Birth*. New York, NY: Childbirth Connection; 2013.
28. Declercq ER, Sakala C, Corry MP, Applebaum S. Listening to mothers II: Report of the second national U.S. survey of women's childbearing experiences. *J Perinat Educ*. 2007;16(4):15-17.
29. Martin JA, Hamilton BE, Ventura SJ, Osterman MJK, Mathews TJ. Births: Final data for 2011. *Natl Vital Stat Rep*. 2013;62(1):1-90.
30. Kennare RM, Keirse MJNC, Tucker GR, Chan AC. Planned home and hospital births in South Australia, 1991–2006: Differences in outcomes. *Med J Aust*. 2010;192(2):76-80.
31. Guise JM, Denman MA, Emeis C, et al. Vaginal birth after cesarean: New insights on maternal and neonatal outcomes. *Obstet Gynecol*. 2010;115(6):1267-1278.
32. Guise JM, Eden K, Emeis C, et al. Vaginal birth after cesarean: New insights. *Evid Report Technol Assess (Full Report)*. 2010;191:1-397.
33. Cunningham FG, Bangdiwala S, Brown SS, et al. National Institutes of Health consensus development conference statement: vaginal birth after cesarean: New insights. March 8–10, 2010. *Obstet Gynecol*. 2010;115(6):1279-1295.
34. Martin JA, Hamilton BE, Ventura SJ, Osterman MJK, Wilson S, Mathews TJ. Births: Final data for 2010. *Natl Vital Stat Rep*. 2012;61(1):1-72.
35. Health Management Associates. *Midwifery Licensure and Discipline Program in Washington State: Economic Costs and Benefits*. Washington, DC: Health Management Associates; 2007.
36. Knight M, Callaghan WM, Berg C, et al. Trends in postpartum hemorrhage in high resource countries: A review and recommendations from the International Postpartum Hemorrhage Collaborative Group. *BMC Pregnancy Childbirth*. 2009;9:55-64.
37. Gregory KD, Korst LM, Lu MC, Fridman M. AHRQ patient safety indicators: Time to include hemorrhage and infection during childbirth. *Jt Comm J Qual Patient Saf*. 2013;39(3):114-122.
38. Lu MC, Fridman M, Korst LM, et al. Variations in the incidence of postpartum hemorrhage across hospitals in California. *Matern Child Health J*. 2005;9(3):297-306.
39. Tebruegge M, Misra I, Pantazidou A, et al. Estimating blood loss: Comparative study of the accuracy of parents and health care professionals. *Pediatrics*. 2009;124(4):e729-736.
40. Yoong W, Karavolos S, Damodaram M, et al. Observer accuracy and reproducibility of visual estimation of blood loss in obstetrics: How accurate and consistent are health-care professionals? *Arch Gynecol Obstet*. 2010;281(2):207-213.
41. Davis D, Baddock S, Pairman S, et al. Risk of severe postpartum hemorrhage in low-risk childbearing women in New Zealand: Exploring the effect of place of birth and comparing third stage management of labor. *Birth Berkeley Calif*. 2012;39(2):98-105.
42. Rath WH. Postpartum hemorrhage: Update on problems of definitions and diagnosis. *Acta Obstet Gynecol Scand*. 2011;90(5):421-428.
43. Schorn MN. Measurement of blood loss: Review of the literature. *J Midwifery Womens Health*. 2010;55(1):20-27.
44. Ecker J, Minkoff H. Home birth: What are physicians' ethical obligations when patient choices may carry increased risk? *Obstet Gynecol*. 2011;117(5):1179-1182.
45. Cheyney M. *Born at Home: Cultural and Political Dimensions of Maternity Care in the United States*. Belmont, CA: Wadsworth Cengage; 2011.
46. Davis-Floyd R. Home-birth emergencies in the US and Mexico: The trouble with transport. *Soc Sci Med*. 2003;56(9):1911-1931.
47. Jackson M, Dahlen H, Schmied V. Birthing outside the system: Perceptions of risk amongst Australian women who have freebirths and high risk homebirths. *Midwifery*. 2012;28(5):561-567.
48. Symon A, Winter C, Donnan PT, Kirkham M. Examining autonomy's boundaries: A follow-up review of perinatal mortality cases in UK independent midwifery. *Birth Berkeley Calif*. 2010;37(4):280-287.
49. Killeen OG, Burke C, Devaney D, Clarke TA. The value of the perinatal and neonatal autopsy. *Ir Med J*. 2004;97(8):241-244.
50. Boslaugh S. *Secondary Data Sources for Public Health: A Practical Guide*. New York, NY: Cambridge University Press; 2007.
51. Lash TL, Mor V, Wieland D, Ferrucci L, Satariano W, Silliman RA. Methodology, design, and analytic techniques to address measurement of comorbid disease. *J Gerontol A Biol Sci Med Sci*. 2007;62(3):281-285.
52. Pourasghar F, Malekafzali H, Kazemi A, Ellenius J, Fors U. What they fill in today, may not be useful tomorrow: Lessons learned from studying medical records at the Women hospital in Tabriz, Iran. *BMC Public Health*. 2008;8:139-145.
53. Stommel M, Wills C. *Clinical Research: Concepts and Principles for Advanced Practice Nurses*. Baltimore, MD: Lippincott Williams and Wilkins; 2003.