

Outcomes of Care in Birth Centers: Demonstration of a Durable Model

Susan Rutledge Stapleton, CNM, DNP, Cara Osborne, SD, CNM, Jessica Illuzzi, MD, MS

Introduction: The safety and effectiveness of birth center care have been demonstrated in previous studies, including the National Birth Center Study and the San Diego Birth Center Study. This study examines outcomes of birth center care in the present maternity care environment.

Methods: This was a prospective cohort study of women receiving care in 79 midwifery-led birth centers in 33 US states from 2007 to 2010. Data were entered into the American Association of Birth Centers Uniform Data Set after obtaining informed consent. Analysis was by intention to treat, with descriptive statistics calculated for maternal and neonatal outcomes for all women presenting to birth centers in labor including those requiring transfer to hospital care.

Results: Of 15,574 women who planned and were eligible for birth center birth at the onset of labor, 84% gave birth at the birth center. Four percent were transferred to a hospital prior to birth center admission, and 12% were transferred in labor after admission. Regardless of where they gave birth, 93% of women had a spontaneous vaginal birth, 1% an assisted vaginal birth, and 6% a cesarean birth. Of women giving birth in the birth center, 2.4% required transfer postpartum, whereas 2.6% of newborns were transferred after birth. Most transfers were nonemergent, with 1.9% of mothers or newborns requiring emergent transfer during labor or after birth. There were no maternal deaths. The intrapartum fetal mortality rate for women admitted to the birth center in labor was 0.47/1000. The neonatal mortality rate was 0.40/1000 excluding anomalies.

Discussion: This study demonstrates the safety of the midwifery-led birth center model of collaborative care as well as continued low obstetric intervention rates, similar to previous studies of birth center care. These findings are particularly remarkable in an era characterized by increases in obstetric intervention and cesarean birth nationwide.

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BACKGROUND

For 32 of the last 40 years, US health care costs have grown faster than the country's gross domestic product (GDP)¹ and are projected to be greater than \$3 trillion in 2014, or 18% of the GDP.² Childbirth is the leading cause of hospitalization in the United States, with mothers and newborns accounting for 23% of all hospital discharges in 2008.³ Five of the 10 most commonly performed procedures are associated with childbirth, and cesarean birth is the most common inpatient surgical procedure.⁴ In 2008, hospitalization for pregnancy, birth, and care of the newborn resulted in total hospital charges of \$97.4 billion, making it the single largest contributor as a health condition to the national hospital bill.⁵ Average US payments for vaginal births are far higher than in many countries, including Canada, France, and Australia.⁶

At the same time, many other countries have better birth outcomes than the United States. In 2010, 33 countries had lower maternal mortality rates, 37 countries had lower neonatal mortality rates, 65 countries had lower rates of low birth weight, and 32 countries had higher rates of exclusive breastfeeding to at least 6 months than did the United States.⁷

Federal and state policy makers in the United States are working to identify and promote lower-cost, higher-quality models of care. This concept of better outcomes at lower costs, or "high-value" care, is a driving force in the Patient Protec-

tion and Affordable Care Act (PPACA).⁸ Among several important provisions targeted to the care of pregnant women that the act mandates are payments for facility services to birth centers across the United States (Section 2301 [S.3590]).⁹ The Centers for Medicare and Medicaid Services underscored the importance of examining the birth center model as means of providing high-quality care by including birth center care as one of 3 options for enhanced prenatal care under the Strong Start Initiative in 2012.¹⁰ In addition, both the Institute of Medicine and Childbirth Connection have called for further research about the birth center model of care.^{11,12} The birth center model was established as a high-value model of care by the landmark National Birth Center Study (NBCS, 1985-1987) and the San Diego Birth Center study (1994-1996).^{13,14} These studies demonstrated that birth centers could provide maternity care to low-risk pregnant women, who make up approximately 85% of pregnant women in the United States,¹⁵ safely, effectively, with less resource utilization, and with a resultant high level of patient satisfaction.

The American Association of Birth Centers (AABC) defines the birth center as "a homelike facility existing within the health care system with a program of care designed in the wellness model of pregnancy and birth. Birth centers provide family-centered care for healthy women before, during, and after normal pregnancy, labor, and birth."¹⁶ The birth center is a collaborative model. Most birth centers have midwives as the primary care providers working with physicians and hospitals in a team approach to maternity care. The AABC has established national *Standards for Birth Centers* that are

Address correspondence to Susan Stapleton, CNM, DNP, 7 Hickens Way, #12, Kennebunk, ME 04043. E-mail: susanstapleton71@gmail.com

Quick Points

- ◆ Of 15,574 women planning and eligible for a birth center birth at the onset of labor, 93% experienced a spontaneous vaginal birth regardless of where they ultimately gave birth, whereas 6% had a cesarean birth.
- ◆ Eighty-four percent of women planning a birth center birth at the onset of labor gave birth there, with approximately 2.5% of mothers or newborns requiring transfer to the hospital after birth. Emergent transfer before or after birth was required for 1.9% of women in labor or for their newborns.
- ◆ There were no maternal deaths. The intrapartum fetal mortality rate for women who were admitted to the birth center in labor was 0.47/1000, and the neonatal mortality rate was 0.40/1000 excluding anomalies.
- ◆ The study provides important information for childbearing families for informed decision making regarding their choice of maternity care provider and birth location.
- ◆ This study demonstrates the safety of birth centers and consistency in outcomes over time despite a national maternity care environment with increasing rates of intervention.

used by the Commission for the Accreditation of Birth Centers (AABC), an independent authority that accredits birth centers in the United States.^{17,18} Most birth centers are located outside of hospitals. Some birth centers are physically located inside a hospital building but meet AABC standards for autonomy and are separate from the hospital's acute care obstetric services. In its 1982 policy statement, the American Public Health Association issued guidelines for licensure of birth centers,¹⁹ and birth centers are now licensed in 41 states.²⁰ This infrastructure of standards, accreditation, and licensure provides the foundation for US birth centers and may influence birth center outcomes. According to Centers for Disease Control and Prevention (CDC) data, 0.3% of all US births in 2010 occurred in freestanding birth centers.²¹

In the years since the national and San Diego birth center studies were conducted, maternity care in the United States has become increasingly interventional. A 2005 national survey reported that 90% of women had continuous electronic fetal monitoring, and 76% of women received epidural analgesia during labor.²² According to CDC data, induction of labor was performed in 22.8% of all births in 2007, an increase of 140% since 1990 (9.5%).²³ The cesarean birth rate increased from 4.5% in 1965 to 22.7% in 1985 and to 32.8% in 2010.^{21,24,25} In light of these changes in the overall US maternity care environment, this study aimed to describe the outcomes of birth center care in the current era so that consumers, providers, policy makers, and insurers have up-to-date, evidence-based information.

METHODOLOGY

Data Collection

Data were collected using the AABC Uniform Data Set (UDS), an online data registry developed by the AABC with a task force of maternity care and research experts. The UDS was developed in accordance with the guidelines for data registries developed by the Agency for Healthcare Research and Quality.^{26,27} Participation in the registry is voluntary, and 78% of AABC-member birth centers contribute to the registry. Forty-one percent of all US birth centers known to the AABC are members.

Written informed consent is obtained from all participants prior to entry into the registry. The data are stored securely in a password-protected database. The AABC maintains a data access policy that requires investigators to request access to the data. Requests are reviewed by the AABC Research Committee, and determinations of appropriate access to and use of data are made in accordance with the Federal Policy for the Protection of Human Subjects.²⁸ The University of Arkansas institutional review board determined this descriptive study using registry data to be exempt from approval because the data do not include any personal identifiers.

The AABC UDS collects data on 189 variables that describe the demographics, risk factors, processes of care, and maternal-infant outcomes of women receiving care in birth centers. Data are collected prospectively, with the patient record created during the initial prenatal visit. Data on the patient's antenatal course are summarized when she either terminates prenatal care prior to labor or is admitted for intrapartum care. Data to describe intrapartum, immediate postpartum, and neonatal courses are entered after the birth. Data to describe the postpartum and neonatal course are entered following a visit 4 to 6 weeks after the birth. Outcome data are collected on all mothers and infants who remain in care, regardless of place of birth. All data are collected by the woman's primary care provider. Providers enter data directly, or trained clerical staff enters data from paper forms completed by providers via a secure Web-based portal, and the data are stored in a MySQL database.

Those entering data were provided with a detailed *UDS Instruction Manual* that includes data definitions, use of the Web-based collection tool, data collection procedures, and implementation of a data entry system within the practice.²⁹ Training workshops were presented by the AABC Research Committee throughout the study period. Research team members were available to provide support such as interpretation of data definitions and coding decisions in specific cases. AABC newsletters and e-mails were used to communicate with birth centers regarding any common data quality issues identified.

Once the data have been entered, a designated on-site UDS coordinator reviews entries, and errors are corrected prior to final submission of the data to the database. The UDS online form includes required fields to ensure that the form cannot be submitted without certain critical data such as transfer information and important perinatal outcome data. The UDS data are monitored by the AABC research team for records that have not been completed by established deadlines, coding errors, and unexpected discrepancies, using established validation parameters such as logical consistency to other data fields for the same patient. Birth centers are queried via e-mail or phone to obtain correct information. A log is maintained of all data modifications for correction of errors.

A validation study of the UDS was conducted in 2010 and found a high level of consistency between UDS registry data and matched medical records in 5 birth centers that were representative of those contributing data to the registry. Registration and birth logs were reviewed to confirm that all women who registered for care in each practice and consented for data collection had been entered in the UDS. At least 2% of each practice's records were randomly selected and audited for 25 key variables, with the medical record as the criterion standard. All variables audited showed at least 90% consistency between the 2 data sources, and there was 100% consistency for 10 variables.³⁰ All women in the audited practices were presented the option of participating in the UDS data registry. Women declined participation very rarely, and there were no recorded instances of women choosing to withdraw.³¹ All study variables used in the current analysis are among the variables included in the validation study.

Inclusion Criteria

This report examines intrapartum care and perinatal outcomes of women who received care in birth centers that contributed to the UDS, entered labor eligible for and planning a birth center birth, and had estimated dates of birth during 2007 through 2010. Eligibility criteria for birth center birth were established by the AABC and CABC and included singleton, full-term gestation in vertex presentation with no medical or obstetric risk factors precluding a normal vaginal birth or necessitating interventions such as continuous electronic fetal monitoring or induction of labor.¹⁷ Estimated date of birth, rather than actual date of birth, was used for establishing eligibility to ensure the inclusion of participants who transferred care during the antepartum period for whom date of birth was less likely to be available. All study variables (Appendix 1) were analyzed for both those women who gave birth in the birth center and those who required transfer to hospital care after onset of labor.

Data Analysis

Data were transferred from the MySQL database to SAS version 9.1 (Cary, North Carolina) for analysis. Descriptive statistics for demographic variables and perinatal outcomes were calculated, and frequencies are reported. Denominators were adjusted to account for missing data and are reported with frequencies.

RESULTS

A total of 79 birth centers in 33 US states (Appendix 2) contributed data to the AABC UDS during the study period of January 1, 2007, to December 31, 2010. Birth centers participating in this study were representative of overall AABC-member birth centers in terms of provider type, geographic distribution, payer mix, volume, and demographics of women served.³² No birth centers were excluded from the study, as all had acceptable data, which was defined as no more than 5% incomplete records. Fifty-nine birth centers (75%) contributed data throughout the study period, 15 (19%) began contributing data after 2007, and 5 (6%) closed during the study period. Fifty of the birth centers contributing data (63%) were accredited by the CABC, 3 of those were accredited by both the CABC and the Joint Commission, and 29 (37%) were not accredited. Certified nurse-midwives (CNMs) were the primary care providers in 63 of the birth centers (80%). Certified professional midwives (CPMs) or licensed midwives (LMs) provided care in 11 participating birth centers (14%). In 5 participating centers (6%), care was provided by teams of CNMs, CPMs, and LMs. A comparison of the professional midwifery credentials in the United States is available from the American College of Nurse-Midwives.³³

There were 22,403 complete client records in the UDS for women with an estimated date of birth between January 1, 2007, and December 31, 2010, who intended to give birth in a birth center when registering for prenatal care (Figure 1). The most common reasons for leaving birth center care during pregnancy were nonmedical (15.1%), such as moving to another area or changing provider or planned birth location. Nearly a thousand women (4.2%) did not remain pregnant past the first trimester because of spontaneous or induced abortion or ectopic pregnancy. Of the 18,084 women who continued in birth center care, 2474 women (13.7%) were referred to physician care for medical or obstetric complications precluding birth center care. Of these antepartum medical referrals, the most common indications were postdates (10.7%), malpresentation (10.4%), preeclampsia (9.3%), and nonreassuring fetal testing (8.6%). Thirty-six women (0.2%) never presented to the birth center in labor because of nonmedical reasons such as choosing to present at a hospital en route or giving birth at home because of precipitous labor. The remaining 15,574 women planned and were eligible for birth center birth at the onset of labor and make up the study sample presented in the results that follow.

Demographic Characteristics

Demographics for the study participants are presented in Table 1. Federal or state government programs (Medicaid, Medicare, Children's Health Insurance Program [CHIP], or TRICARE) were the primary payers for nearly a third of births. The majority of the study population was white, non-Hispanic; aged between 18 and 34 years; and had a college degree. Slightly fewer than half were nulliparous. The most common issue from medical history was overweight/obesity (5.7%), followed by depression or psychiatric disease requiring treatment (3.3%). The reported rates of smoking (1.5%) and substance abuse (0.5%) were very low. Problems in the

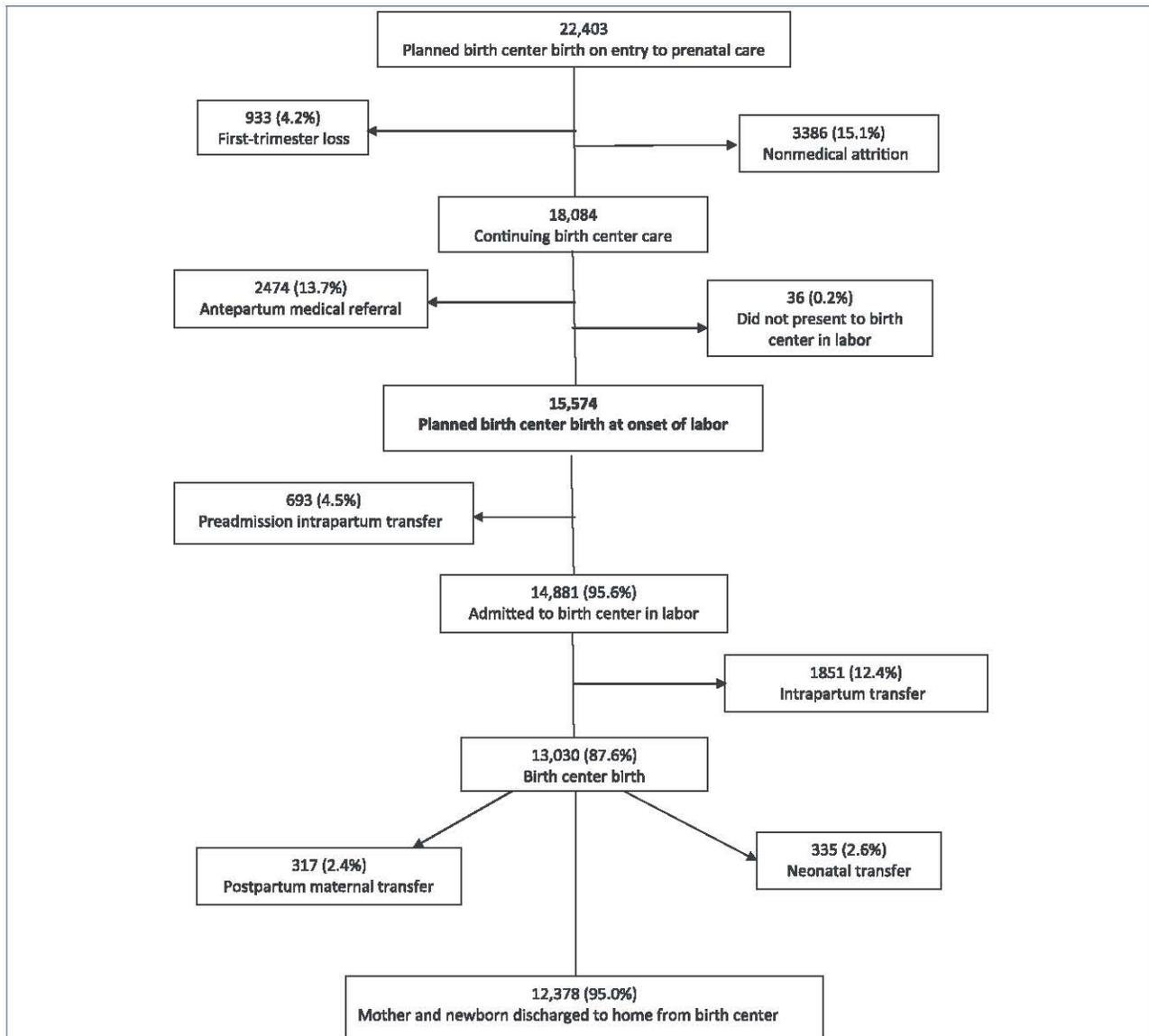


Figure 1. Study Flowchart

current pregnancy occurred in 17.5% of women, the most common of which were infections (4.6%), anemia (2.9%), and postdates (2.6%).

Intrapartum Admissions and Transfers

Of the 15,574 women who planned birth center birth at the onset of labor, 95.6% were admitted to the birth center in labor, and 4.5% were referred to hospital care before being admitted to the birth center. Among those referred to the hospital prior to admission, the most common reasons were term rupture of membranes without labor (20.4%), client choice (10.0%), and malpresentation (9.1%).

Of the 14,881 women who were admitted to the birth center in labor, 87.6% gave birth there, whereas 12.4% were transferred to the hospital prior to giving birth, with 11.5% referred to the hospital nonemergently. The majority (63.6%) of the nonemergent intrapartum referrals after admission to the birth center in labor were for prolonged labor or arrest of

labor. Arrest during the first stage of labor occurred 3 times more frequently than arrest in the second stage of labor. Fewer than 1% of the women (0.9%) required emergent intrapartum transfers. Half the emergency intrapartum transfers were responses to nonreassuring fetal heart rate patterns noted with intermittent auscultation (Table 2). Nulliparas accounted for 81.6% of the intrapartum referrals and transfers. The AABC's definitions of referral and transfer with examples of each type can be found in Appendix 3.

Mode of Birth

Cephalic spontaneous vaginal births were the most common (92.3%), cesarean births and operative vaginal births were uncommon, and spontaneous breech vaginal births were the least common (Table 3). Trial of labor after cesarean (TOLAC) was infrequent in this population, as few birth centers were allowing TOLACs during the study period. Seventy percent of the 56 TOLACs were successful. Of the 1851 women who

	n (%)
Age, y^a	
<18	171 (1.1)
18-34	13,218 (85.4)
≥35	2093 (13.5)
Race^b	
Non-Hispanic White	11,810 (77.4)
Hispanic	1711 (11.2)
Black	840 (5.5)
Asian or Pacific Islander	349 (2.3)
Native American or Native Alaskan	101 (0.7)
Unknown or other	440 (2.9)
Marital status^c	
Married	12,109 (80.1)
Unmarried	3015 (19.9)
Parity at onset of labor	
Nulliparous	7355 (47.2)
Parous	8219 (52.8)
Payment method	
Private insurance	8325 (53.5)
Medicaid	3701 (23.8)
Self-pay	2261 (14.5)
Military coverage	411 (2.6)
Other insurance/grants	406 (2.6)
Medicare	374 (2.4)
Unknown	96 (0.6)
Education, y^d	
<12	1184 (8.7)
12	2669 (19.6)
13-15	2727 (20.0)
≥16	7067 (51.8)

^an = 15,482 due to missing data.

^bn = 15,251 due to missing data.

^cn = 15,124 due to missing data.

^dn = 13,647 due to missing data.

presented in labor and were transferred to hospitals, more than half (54.7%) had spontaneous vaginal births, 37.8% had cesarean births, and 7.5% had operative vaginal births.

Postpartum and Neonatal Complications

The immediate postpartum course was uncomplicated for 91% of the study population, regardless of where they gave birth. The majority of women experiencing postpartum complications had postpartum hemorrhage (68.2%). Most postpartum hemorrhages (92.6%) were managed in the birth center. Postpartum transfer to the hospital was required for 2.4% of women who gave birth in the birth center, with 1.9% referred nonemergently and 0.5% of women requiring emergent postpartum transfer. Postpartum hemorrhage was the

	n (%)
Intrapartum, n = 140	
Nonreassuring fetal heart rate pattern ^a	72 (51.4)
Arrest of labor ^b	24 (17.1)
Malpresentation ^c	14 (10.0)
Abnormal intrapartum bleeding ^d	7 (5.0)
Pregnancy-induced hypertension/preeclampsia ^e	6 (4.3)
Cord prolapse ^f	4 (2.9)
Seizure	1 (0.7)
Other	12 (8.6)
Postpartum, n = 67	
Postpartum hemorrhage ^g	36 (53.7)
Retained placenta ^h	23 (34.3)
Pregnancy-induced hypertension/preeclampsia ^e	1 (1.5)
Other	5 (7.5)
Unknown	2 (3.0)
Newborn, n = 94	
Respiratory issues ⁱ	66 (70.2)
5-Minute Apgar <7	11 (11.7)
Birth trauma ^j	3 (3.2)
Small for gestational age ^k	1 (1.1)
Prematurity ^l	1 (1.1)
Other	12 (12.8)

^aNonreassuring fetal heart rate pattern: includes prolonged bradycardia, severe variables, and late decelerations.

^bFirst-stage prolonged/arrest of labor: slower than expected labor progress or patient in active labor who has had cervical change, then has no further progress for at least 2 hours. Second-stage prolonged/arrest of labor: slower than expected descent or no descent after 2 hours for primigravida or one hour for multigravida without epidural or after 3 hours for primigravida or 2 hours for multigravida with epidural.

^cMalpresentation: breech, face, brow, compound, transverse lie.

^dIntrapartum bleeding: greater than expected for "bloody show."
^ePregnancy-induced hypertension/preeclampsia: systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg with or without signs and symptoms of preeclampsia.

^fCord prolapse: cord is presenting in front of the presenting part, including frank or occult prolapse.

^gPostpartum hemorrhage: estimated blood loss >500 mL for vaginal birth and >1000 mL for cesarean birth.

^hRetained placenta: placenta requiring manual removal or other out-of-the-ordinary third-stage interventions, regardless of the length of third stage.

ⁱRespiratory distress: respiratory rate ≥ 60/minute accompanied by grunting and/or retractions. Includes apnea. ^jTransient tachypnea: respiratory rate ≥ 60/minute without retractions or grunting.

^kBirth trauma: fetal injury related to the process of birth or obstetric interventions, includes cephalohematoma, abscess at site of scalp lead or scalp blood sampling, subgaleal hematoma, significant caput succedaneum, abrasions and lacerations, brachial plexus injury, cranial nerve injury, laryngeal nerve injury, clavicular or long-bone fracture, hepatic rupture, and hypoxic-ischemic insult (confirmed by cord blood gases and other testing).

^lSmall for gestational age: weight <10th percentile for gestational age.

^mPrematurity: less than 37 weeks' gestation by gestational age exam.

most common reason for nonemergent referral and emergent transfers (Table 2).

Transport to the hospital was required for 2.6% of neonates born at birth centers, with 1.9% nonemergent referrals and 0.7% requiring emergent transfer. The most common indications for nonemergent referral and emergency transfer were respiratory issues (Table 2).

Overall, 79.4% of women who entered labor planning a birth center birth gave birth in the birth center and were

Table 3. Mode of Birth for All Women Planning a Birth Center Birth at Onset of Labor Regardless of Site of Birth (N = 15,574)

	n (%)
Spontaneous vaginal birth	14,437 (92.8)
Cephalic	14,373 (92.3)
VBAC	39 (0.3)
Breech	25 (0.2)
Assisted vaginal birth	188 (1.2)
Vacuum	148 (1.0)
Forceps	40 (0.3)
Cesarean birth	949 (6.1)
Primary	930 (6.0)
Repeat	19 (0.1)
With trial of labor	17 (0.1)
Without trial of labor ^a	2 (0.0)

Abbreviation: VBAC, vaginal birth after cesarean.

^aChanged mind at onset of labor and presented at hospital for repeat cesarean birth.

discharged from there to home with their newborns. Fewer than 2% (1.9%) of the study sample required emergent transfer during labor or after birth of either the mother or newborn.

Mortality

There were no maternal deaths in the study population. There were 14 fetal deaths and 9 neonatal deaths. Seven of the fetal deaths (50%) occurred before women arrived at the birth center. Of these, 5 were diagnosed with intrauterine fetal demise (IUID) on arrival at the birth center and then transferred directly to a hospital, whereas 2 were diagnosed with IUID on arrival, but with birth imminent and no time to transfer. Seven fetal deaths (50%) occurred after women were admitted to the birth center in labor. Four of these occurred to women who were transferred emergently for nonreassuring fetal heart tones on auscultation and 3 to women who labored and had unexpected stillbirths at the birth center.

There were 9 neonatal deaths, of which 7 were unexpected. Two women whose infants had been prenatally diagnosed with lethal anomalies chose to give birth at a birth center, where one infant died shortly after birth and the other was discharged home with the family and died there. A third infant, transferred after birth, had a previously undiagnosed diaphragmatic hernia despite having had a second trimester fetal anatomy survey. Of the remaining 6 deaths, 3 were among infants whose mothers were transferred intrapartum. Two were emergent transfers for nonreassuring fetal status, and the respective causes of death were avulsion of a velamentous cord insertion and chronic fetal-maternal transfusion antenatally. The third was a nonemergent transfer for arrest of the first stage of labor with a subsequent cesarean for failed oxytocin augmentation; meconium aspiration was the probable cause of death. The other 3 infants were transferred emergently after birth: 2 had respiratory distress syndrome and one had hypoxic ischemic encephalopathy attributed to a prenatal insult documented on neuroimaging. All died within 7 days of

birth. The intrapartum fetal mortality rate for the women who were admitted to the birth center in labor was 0.47/1000. The neonatal mortality rate was 0.40/1000 excluding anomalies.

DISCUSSION

These findings are consistent with those from Cochrane reviews of place of birth and midwifery-led care,^{34,35} British studies of place of birth,^{36,37} and US studies comparing midwifery and obstetric care,³⁸⁻⁴⁰ which suggest that midwifery-led birth center care is a safe and effective option for medically low-risk women.

The intrapartum fetal and neonatal mortality rates found in this study are comparable to those reported in many studies of low-risk women. Women starting care in labor with midwives in a primary care setting in the Netherlands experienced an intrapartum fetal death rate of 0.96/1000 and a perinatal mortality rate of 1.39/1000, excluding newborns with congenital anomalies.⁴¹ The US neonatal mortality rate in 2007 was 0.75/1000 for newborns weighing 2500 g or greater.⁴² A study in Scotland of neonatal death rates by time of birth for term infants without anomalies reported an overall neonatal mortality rate of approximately 0.5/1000.⁴³ A National Perinatal Epidemiology Unit study of low-risk women in England found a neonatal mortality rate of 1.78/1000.³⁷ A comparison of outcomes for low-risk women under midwifery-led care and obstetrician care in Ireland found perinatal mortality rates of 2.76/1000 and 3.66/1000, respectively.⁴⁴ In a comparison of outcomes of planned home births attended by registered midwives, hospital births attended by registered midwives, and low-risk hospital births attended by obstetricians in British Columbia, Canada, perinatal death rates were 0.35/1000, 0.64/1000, and 0.57/1000, respectively.⁴⁵

The findings of this study are also strikingly similar to those of the National Birth Center Study, which was based on data collected from mid-1985 through 1987. The authors reported an intrapartum fetal mortality rate of 0.3/1000 and neonatal mortality rate of 0.3/1000, excluding anomalies. Mortality, transfer, complication, and operative birth rates were similar despite differences in the 2 study populations that might be expected to contribute to more adverse outcomes in the current study; a higher proportion of women in the current study were aged 35 or older, black, unmarried, and nulliparous than the women in the National Birth Center Study.^{13,46} This consistency speaks to the durability of the birth center model over time, despite increases in the rates of intervention and cesarean birth nationwide during the same period.

Strengths of the study include a relatively large sample size, geographic diversity of birth centers contributing data, and data collection over a period of 4 years. As with many multicenter studies, data were collected and entered by care providers. Although this creates a potential for bias and error, findings from the validation study³⁰ and the consistency of data across birth centers suggest that the data are reliable. Although there were missing demographic data, all other variables reported here are required fields in the UDS without which the form cannot be submitted; therefore, there were no incomplete data for other variables for this cohort.

The birth centers contributing data to the AABC UDS may have been different from those birth centers not contributing data. The study birth centers are AABC members and thus have access to continuing education activities and support the organization's model and *Standards for Birth Centers*.¹⁷ This potential difference means that the findings may not be generalizable to all birth centers.

The provider made all coding decisions based on their interpretation of the data definitions, including the decision to designate a transfer as emergent. Review of the indications for emergency intrapartum transfer showed that some did not appear to be actual medical emergencies. For example, 24 women were transferred emergently for arrest of labor, which is unlikely to be a true medical emergency. Consequently, the incidence of actual medical emergencies requiring transfer is likely to have been lower than reported here.

The decreased direct and indirect costs to the health care system associated with birth center care make it a model that warrants thorough examination. Given that nearly half of all births in the United States (42.9%) are currently funded by Medicaid and CHIP programs,⁴⁷ it is worth considering the potential savings if more pregnant women receiving government-supported care gave birth in birth centers.

Despite the PPACA federal mandate, the AABC Legislative Committee reports that many states have not yet implemented appropriate birth center facility reimbursement. Medicaid facility reimbursement for birth centers varies widely across states in which birth centers are reimbursed; however, in 2011, the average Medicaid reimbursements in general were similar to national Medicare reimbursement rates.⁴⁸ The Medicare facility reimbursement for care of mother and newborn for an uncomplicated vaginal birth in a hospital in 2011 was \$3998,⁴⁹ compared with \$1907 in a birth center.³² Thus, the 13,030 birth center births in this cohort saved an estimated \$27,245,469 in payments for facility services compared with hospital vaginal births at current Medicare rates. Even with birth center facility reimbursement rates increased to more equitable levels, cost savings would remain significant.

The cesarean birth rate in this cohort was 6% versus the estimated rate of 25% for similarly low-risk women in a hospital setting.²¹ Had this same group of 15,574 low-risk women been cared for in a hospital, an additional 2934 cesarean births could be expected. The Medicare facility reimbursement for an uncomplicated cesarean birth in a hospital in 2011 was \$4465.⁴⁹ Given the increased payments for facility services for cesarean birth compared with vaginal birth in the hospital, the lower cesarean birth rate potentially saved an additional \$4,487,524. In total, one could expect a potential savings in costs for facility services of more than \$30 million for these 15,574 births.

The potential savings from the cost of care and lower intervention rates highlight birth centers as an important option for providing high-value maternity care. Cost analysis of birth center care is therefore an important area for future research, and fair and timely reimbursement for birth center care is important to the sustainability and further dissemination of the model.

The findings of this study also provide information to families considering birthing at a birth center. Among women

who entered labor planning a birth center birth in this study, 83.7% gave birth there, and 79.4% ultimately were discharged from there to home with their newborns. Fewer than 2% (1.9%) required emergent transfer to a hospital for either mother or newborn. The total cesarean birth rate in the study sample was 6% regardless of where birth occurred. The fetal and neonatal mortality rates were consistent with those of births among low-risk women in previous studies including hospital settings. This information is helpful to families in making informed choices about their birth setting and maternity care provider.

This data set is rich and includes information on the elements of birth center care that have contributed to these outcomes. Future research should be carried out to describe the cost components of birth center care and strategies for optimizing and expanding this high-value care model. Qualitative studies exploring the experiences of childbearing women and families in birth center and hospital models of care are also critical.

Birth centers and their midwifery-led, collaborative model of maternity care continue to offer an important solution to many of the issues affecting the quality and cost of maternity care in the United States. This study confirms the findings of the National Birth Center Study and other studies of the birth center model of care and adds to the evidence demonstrating excellent maternal and infant outcomes for women receiving midwifery-led care in birth centers.

AUTHORS

Susan Stapleton, CNM, DNP, FACNM, is Research Committee Chair of the American Association of Birth Centers and has 25 years' experience owning and practicing in a birth center.

Cara Osborne, CNM, SD, is a midwife and perinatal epidemiologist and is assistant professor at the Eleanor Mann School of Nursing at the University of Arkansas.

Jessica Illuzzi, MD, MS, FACOG, is Associate Professor of Obstetrics, Gynecology, and Reproductive Sciences at Yale University School of Medicine and serves on the board of directors and is Standards Committee Chair of the American Association of Birth Centers.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose

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Appendix 1. Study Variables for Outcomes of Birth Center Care

Demographics

Maternal age at presentation to prenatal care
 Payment method
 Education level
 Maternal race/ethnicity
 Marital status
 Gravidity and parity
 Medical history
 Psychosocial history
 Intended place of birth at onset of prenatal care
 Estimated date of birth

Antepartum referral

Antepartum complications
 Type of antepartum referral
 Primary indication for antepartum referral

Intrapartum

Type of intrapartum transfer
 Primary indication for intrapartum transfer

Pregnancy outcome

Place of first admission to intrapartum care
 Place of birth
 Type of birth
 Live birth
 Intrapartum fetal death

Postpartum

Type of postpartum transfer
 Primary indication for postpartum transfer
 Postpartum hemorrhage

Neonatal

Type of neonatal transfer
 Primary indication for neonatal transfer
 Neonatal death

Provider characteristics

Primary provider for prenatal care
 Birth attendant

Appendix 2. Participating Birth Centers

Alaska Family Health and Birth Clinic, Fairbanks, Alaska
 Allen Birthing Center, Allen, Texas
 Auburn Birthing Center LLC, Auburn, Indiana
 Austin Area Birthing Center, Austin, Texas
 Babymoon Inn, LLC, Phoenix, Arizona
 Bay Area Midwifery Center, Annapolis, Maryland
 Best Start Birth Center, San Diego, California
 Birth & Women's Health Center, Tucson, Arizona
 Birth and Beyond, Grandin, Florida
 Birth Care and Family Health Service, Bart, Pennsylvania
 Birth Care and Women's Health, Alexandria, Virginia
 Birth Center of Gainesville, Gainesville, Florida
 BirthWise, Appleton, Wisconsin
 Breath of Life Women's Health Services and Birth Center, Largo, Florida
 Brooklyn Birthing Center, Brooklyn, New York
 Cambridge Birth Center, Cambridge, Massachusetts
 Central Montana Birth Center, Great Falls, Montana
 Charleston Birth Place Charleston, Charleston, South Carolina
 Columbia Birth Center Kennewick, Kennewick, Washington
 Columbia Community Birth Center, Columbus, Missouri
 Connecticut Childbirth and Women's Center, Danbury, Connecticut
 Edenway Birth Center, Cleburne, Texas
 Family Beginnings Birth Center at Miami Valley Hospital, Dayton, Ohio
 Family Birth Center of Naples, Naples, Florida
 Family Birth Center, LLC, Great Falls, Montana
 Family Health and Birth Center, Washington, District of Columbia
 Family Health and Birth Center, Savannah, Georgia
 Family Maternity Center of the Northern Neck, Kilmarnock, Virginia
 Footprints In Time Midwifery Services, Black River Falls, Wisconsin
 Geneva Woods Birth Center, Anchorage, Alaska
 Goshen Birth Center, Goshen, Indiana
 Healing Passages Birth & Wellness Center, Des Moines, Iowa
 Health Foundations Family Health and Birth Center, St. Paul, Minnesota
 Heart 2 Heart Birth Center LLC, Sanford, Florida
 Holy Family Birth Center, Weslaco, Texas
 Infinity Birthing Center-Nashville, Nashville, Tennessee
 Inland Midwife Services, Redlands, California
 Juneau Family Birth Center, Juneau, Alaska
 Katy Birth Center, Katy, Texas
 Labor of Love Birth Center, Lakeland, Florida
 Labor of Love Birth Center Dunedin, Dunedin, Florida

Continued

Appendix 2. Participating Birth Centers

Labor of Love Birth Center for Tampa, Tampa, Florida
Lisa Ross Birth and Women's Center, Knoxville, Tennessee
Madison Birth Center, Madison, Wisconsin
Mamatoto Resource and Birth Centre, Port of Spain, Trinidad
and Tobago
Mat-Su Midwifery, Wasilla, Alaska
Memorial Hospital Family Birthing Center, North Conway,
New Hampshire
Midwife Center for Birth and Women's Health, Pittsburgh,
Pennsylvania
Midwifery Center at DePaul, Norfolk, Virginia
Morning Star Women's Health and Birth Center, Menomonie,
Wisconsin
Morning Star Women's Health and Birth Center, St. Louis Park,
Minnesota
Motherly Way Maternity Service, Midland, Texas
Mother's Own Birth and Women's Center, Temperance, Michigan
Mountain Midwifery Center, Englewood, Colorado
Natchez Trace Maternity Center, Waynesboro, Tennessee
Nativiti Women's Health and Birth Center, The Woodlands, Texas
Natural Beginnings Birth & Wellness Center, Whittier, California
North Houston Birth Center, Houston, Texas
Park Nicollet, St. Louis Park, Minnesota
Nurse-Midwifery Birth Center, Springfield, Oregon
Reading Birth & Women's Center, Reading, Pennsylvania
Rite of Passage Women's Health and Birth Center, Pearland, Texas
Sage Femme Birth Center of Kansas City, Kansas City, Kansas
Sage Femme Midwifery Service/Community Childbearing
Institute, San Francisco, California
San Antonio Birth Center, San Antonio, Texas
South Coast Midwifery and Women's Health Care, Irvine,
California
Special Beginnings Birth & Women's Center, Arundel, Maryland
The Baby Place, Meridian, Idaho
The Birth Center, Bryn Mawr, Pennsylvania
The Birth Center, Missoula, Montana
The Birth Center, A Nursing Corporation, Sacramento, California
The Birth Center: Holistic Women's Health Care, Wilmington,
Delaware
The Birth Place, Taylor, Michigan
The Midwife's Place, Bellevue, Nebraska
Valley Birthplace and Woman Care, Huntingdon Valley,
Pennsylvania
Women's Birth & Wellness Center, Chapel Hill, North Carolina
Women's Health and Birth Center, Santa Rosa, California
Women's Health & Birth Options, Missoula, Montana
Women's Wellness and Maternity Center, Madisonville, Tennessee

Appendix 3. American Association of Birth Centers Transfer Definitions²⁷

Type of Transfer	Definition	Examples
Medical attrition	No birth after 20 weeks' gestation is expected.	SAB Induced abortion Ectopic pregnancy
Nonmedical attrition	Changed from practice or original decision for intended birth site for nonmedical reasons.	Moved out of area Client wanted another provider or place of birth
Antepartum medical referral	Risk factor develops during pregnancy that makes birth in intended location or with intended provider inappropriate.	Hypertension Postdates Multiple gestation Gestational diabetes Malpresentation IUGR Nonreassuring fetal testing
Preadmit intrapartum referral	Risk factor identified on initial evaluation in labor that makes birth in intended location or with intended provider inappropriate.	Malpresentation MSAF Elective or client choice Prolonged prodromal labor Nonreassuring FHR pattern Preterm labor Term prelabor ROM
Intrapartum referral	Risk factor identified after admission in labor that makes birth in intended location or with intended provider inappropriate.	Arrest of labor/prolonged labor Psychological factors MSAF Malpresentation Hypertension/preeclampsia Abnormal intrapartum bleeding Prolonged ruptured of membranes
Emergency intrapartum transfer ^a	Risk factor is identified in labor that requires transfer to acute care setting or to another provider. Situation is urgent, and rapid transport is required.	Cord prolapse Nonreassuring FHR pattern Seizure Abruptio
Postpartum referral	Risk factor is identified during postpartum requiring referral to acute care or to another provider. Not an emergency situation; transport time is not a significant factor.	Maternal fever Laceration requiring repair by physician Retained placenta Mild/moderate PPH
Emergency postpartum transfer ^a	Risk factor during postpartum which requires transfer to acute care setting or to another provider. Situation is urgent and rapid transport time is required.	Maternal seizure Severe PPH Retained placenta with PPH
Newborn referral	Newborn risk factor is identified that requires referral to acute care setting or another provider. Not an emergency; transport time is not a significant factor.	Transient tachypnea Temperature instability Congenital anomaly Suspected infection Mild respiratory distress
Emergency newborn transfer ^a	Newborn risk factor is identified that requires transport to acute care setting or to another provider. Situation is urgent, and rapid transport is required.	Significant respiratory distress Major congenital anomaly Resuscitation >5 minutes

Abbreviations: FHR, fetal heart rate; IUGR, intrauterine growth restriction; MSAF, meconium-stained amniotic fluid; PPH, postpartum hemorrhage; ROM, rupture of membranes; SAB, spontaneous abortion.

^aDetermination of whether transfer is emergency is made by provider.