National Vital Statistics Reports

Volume 62, Number 2 July 22, 2013

Assessing the Quality of Medical and Health Data From the 2003 Birth Certificate Revision: Results From Two States

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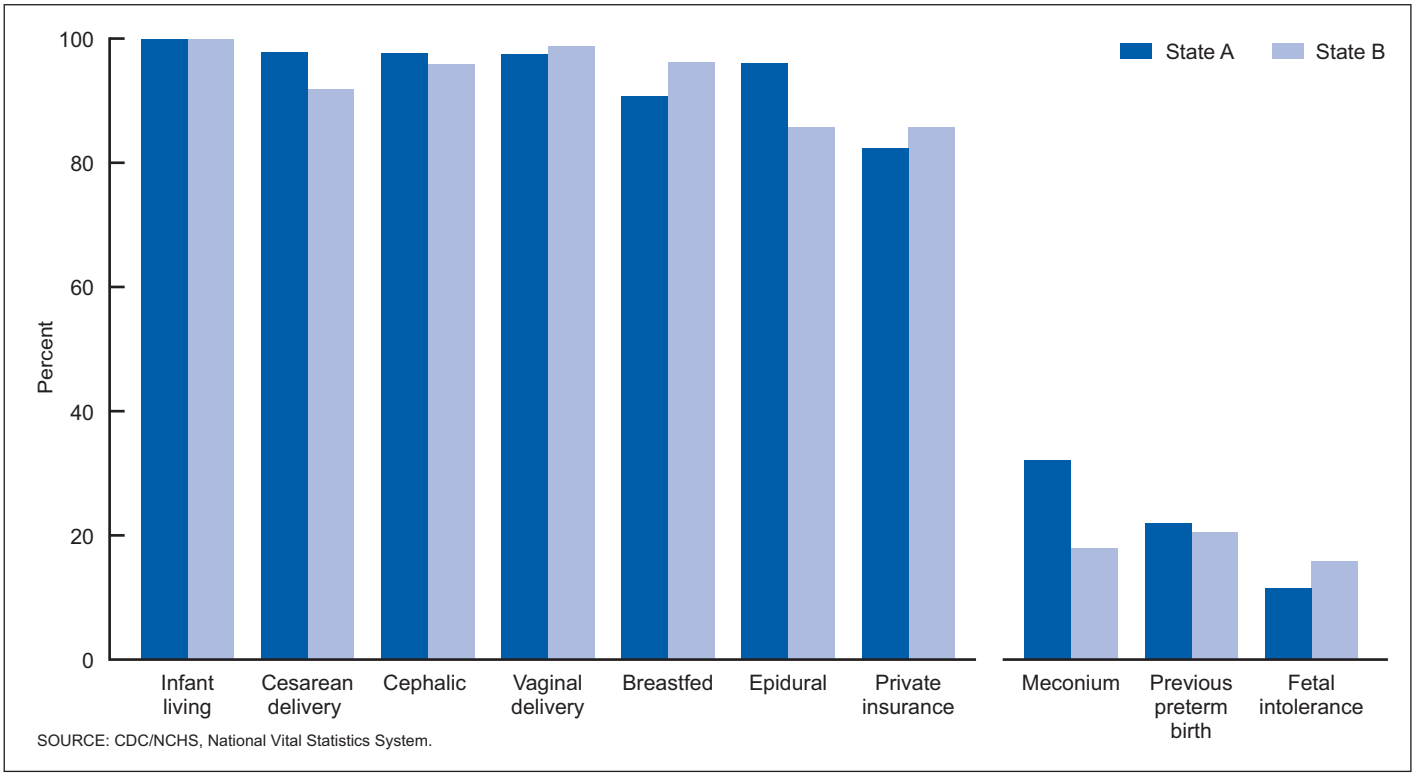

Figure 1. Checkbox items with high sensitivity and extremely low sensitivity for states A and B

Abstract

Objectives—A primary goal of the 2003 revision of the U.S. Standard Certificate of Live Birth was to improve data quality, in part by improving data sources, definitions, and instructions. This report evaluates the quality of selected medical and health data from the 2003 revision of the birth certificate by comparing birth certificate data with information abstracted from hospital medical records.

Methods—A random sample of records for 600 births that occurred in 2010–2011 in State A, and a convenience sample of 495 births that occurred in State B in 2009 were reviewed. Birth certificate and hospital medical record data were compared for these categories: pregnancy history, prenatal care, gestational age, birthweight, pregnancy risk factors, obstetric procedures, onset of labor, source of payment, characteristics of labor and delivery, fetal presentation, method of delivery, abnormal conditions of the newborn, infant living, and infant breastfed.

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Levels of missing data, exact agreement, kappa scores, sensitivity, and false discovery rates are presented, where applicable.

Results—Exact agreement or sensitivity, was high for a number of items for both states (e.g., number of cesarean deliveries, cephalic presentation, cesarean delivery, and birthweight within 500 grams), but exact agreement or sensitivity was low or extremely low for both states for several items (e.g., total number of prenatal visits, previous preterm birth, meconium staining, and fetal intolerance of labor) (Figure 1). Levels of agreement or sensitivity for most items (e.g., prenatal care beginning in first trimester and source of payment—private insurance) were substantial or moderate. Data quality varied by state, and often, varied widely by hospital.

Keywords: data quality • validity • prenatal care • gestational age

Introduction

Information from the U.S. birth certificate is used extensively to track trends in demographic characteristics, health care utilization, obstetric procedures, and maternal and infant health. In more recent years, these data also have been more widely used in obstetric and perinatal research (1–4). A chief advantage of birth certificate data is that information is collected for essentially every birth occurring in the country each year, allowing for analysis of subpopulations, and rare conditions and events. The quality of birth certificate health data, however, is of long-standing concern. Studies evaluating 1989 birth certificate revision-based data have consistently shown that the demographic and selected medical and health items (i.e., method of delivery, birthweight, and plurality) are collected with a high degree of completeness and accuracy, but many of the health and medical items are underreported (5–10).

Accordingly, the key objective of the latest revision—the 2003 U.S. Standard Certificate of Live Birth—was to standardize the data-collection process and improve data quality. The new birth certificate was limited to items that were believed to be collectable with "reasonable completeness and accuracy" (11). A number of steps were taken to enhance the quality of these data: Detailed specifications were developed to guide and standardize design of the state and jurisdictional electronic birth registration systems; worksheets were created to aid in the standardized collection of data from the best sources; and a comprehensive guide with definitions, instructions, recommended sources, and keywords was developed to help hospital staff better understand and report the health and medical information (12,13). Although full national implementation of the 2003 birth certificate has been long delayed, all jurisdictions are expected to implement this change by January 1, 2014. Perhaps, at least in part because of the protracted implementation of the 2003 birth certificate, research evaluating the quality of the new birth data has been limited (14–18). This report is based on a comparison of information obtained from the birth certificate and corresponding information abstracted directly from hospital medical records; it is among the first to assess the validity of medical and health data from the 2003 revision of the birth certificate.

Methods

Data were collected in two states—State "A" and State "B." Data for State A's medical abstraction file were drawn from hospital medical records (including prenatal care records) for a random sample of 600 births occurring in four hospitals (150 births per hospital) in State A from October 2010 through March 2011. The sample frame was based on the sampling methodology used by the Pregnancy Risk Assessment Monitoring System (PRAMS) (19), which draws a stratified systematic sample of new mothers every month from a frame of eligible birth certificates; women who deliver a low-birthweight infant (less than 2,500 grams) are oversampled. State B's medical abstraction data file was drawn from hospital medical records using a convenience sample of the first 125 births occurring in each of four hospitals in State B from September through November 2009. Information for records representing a total of 495 births was abstracted. Information for five records of the original sample was not obtained because of errors in drawing the sample frame.

The four hospitals for each state were selected to have varying characteristics based on quality of vital statistics birth data (i.e., levels of missing data and timeliness); size and location; type (private, public, or training); population served (risk or nonrisk); and type of records used (paper or electronic). The Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS) contracted with a private company to help develop the data collection instrument; to hire and train the abstractors; to handle logistics for the state, hospitals, and the abstractors; and to develop the medical abstraction data files. Four experienced hospital medical data abstractors (two for each state) performed the record reviews. Records from the medical record abstraction data file were linked to the corresponding birth certificate record at NCHS (previously sent to NCHS by the states under the Vital Statistics Cooperative Program), based on the birth certificate number.

Results for the two states are shown separately because of the different sampling designs used. To assess the representativeness of the birth records sampled for each state (Table 1), comparison groups were created of all births occuring in State A from July 1, 2010 through June 31, 2011 and, for State B, all births occurring in 2009. Data for these comparisons are drawn from NCHS' unedited files. Information was abstracted for selected data items included on the U.S. standard facility worksheet (http://www.cdc.gov/nchs/data/dvs/facwksBF04.pdf). Items are categorized as continuous (referred to as noncheckbox items) and categorical (referred to as checkbox items).

The primary measure used to evaluate birth certificate reporting for the noncheckbox items is the "exact agreement" (referred to as agreement in this report). This measure is defined as the percentage of all births for which the values reported on the birth certificate and in the medical records agree. A measure of agreement is also shown for the checkbox items; this measure includes values of both yes (condition reported) and no (condition not reported).

Another, more conservative measure, shown for the categorical checkbox variables is "Cohen's kappa" (kappa). For this study, kappa measures the percentage of agreement of the number of births with a condition indicated by the birth certificate and medical record, adjusted for the percentage of agreement expected by chance, that is, the difference by which the observed agreement on the number of births with a condition exceeds chance agreement. Kappa scores are categorized for consistency with Altman (20–21); see Table A.

The primary measure used to assess correspondence for checkbox items is the sensitivity or true positive rate (referred to as sensitivity in this report), that is, the percentage of births with a condition indicated on the medical record (the "gold standard") that was also indicated on the birth certificate. For classifications of sensitivity levels, see Table A.

Table A. Sensitivity or true positive rates, and Cohen's kappa scores

Sensitivity or true positive rate scale
High (90.0–100.0)
Substantial (75.0–89.9)
Moderate (60.0–74.9)
Low (40.0–59.9)
Extremely low (less than 40.0)
Cohen's kappa score scale
High (0.81–1.00)
Substantial (0.61–0.80)
Moderate (0.41–0.60)
Fair (0.21–0.40)
Slight (0.01–0.20)
Chance (0.00)
Worse than chance (negative score)

NOTES: Sensitivity rates are percentages. Kappa scores are categorized for consistency with Altman; see reference 20.

The false discovery rate (FDR) is also calculated for checkbox items. FDR represents the percentage of births with a condition indicated on the birth certificate that is not indicated on the medical record.

This report includes a number of items that are recodes of one or more items: first trimester prenatal care (prenatal care beginning in the first 3 months of pregnancy, and based on the difference between the date of last normal menses and date of first prenatal visit); total number of prenatal care visits (within two visits); date last normal menses (LMP) began (day within 2 days); percentage of preterm [(LMP-based) births less than 37 completed weeks of gestation, and based on the difference between the date of LMP and the date of birth]; percentage preterm (obstetric estimate-based); obstetric estimate of gestation (within 2 weeks); birthweight within 500 grams; percentage low birthweight (less than 2,500 grams); and percentage very low birthweight (less than 1,500 grams).

Records with missing data on either the birth certificate or the medical records were excluded from the analysis; see "Missing data" and Table 2. Records for which information is not applicable (e.g., trial of labor where the method of delivery is not cesarean delivery) were also excluded from the analysis. Items where the number of cases was less than 20 in the denominator were excluded from the analysis and are denoted with an asterisk (*). Items for which the numerator is 5 or less are denoted by two asterisks (**).

Shortened item titles are used throughout the text and in the figures and tables for ease in reading; full titles for all items are shown in Technical Notes.

Results

Characteristics of study samples

The distributions of births by maternal age were similar in the study samples of each state, compared with all births occurring in each state during the time period (Table 1). The women in the study sample for State A, however, were more likely than all women who had a birth in the state to be non-Hispanic white, less likely to be Hispanic, and much more likely to have a preterm or low-birthweight infant. Conversely, the women in the State B sample were less likely to be non-Hispanic white and more likely to be non-Hispanic black and Hispanic; no differences were seen in the infant outcome measures between the sample and all births in State B.

Missing data

Evaluation of concordance between the medical records and birth certificate should account for proportions of missing data from either the birth certificate or the medical records for the specific item. Overall, for this study, data were less often missing for State A than for State B. The following is a discussion of missing data by type of item.

Pregnancy history—Percentages of missing data from both sources were highest across both states for the pregnancy history items month of last live birth and month of last other pregnancy outcome (approximately 20% for both items and states) (Table 2). Levels of missing data were low (less than 2%) for the number of previous live births now living, the number of previous births now dead, and total number of other pregnancy outcomes. Information for pregnancy history items was missing more often from the medical records than from the birth certificate in both states.

Prenatal care and date of last normal menses—Levels of missing data were less than 2% for State A for all components of the date of the first prenatal visit, but missing-data levels were substantially higher for State B—between 11.5% and 22.8% (Table 2). For both states, data were typically more likely to be missing from the medical records than from the birth certificate. Levels of missing data were 10% or higher for all components of the date of LMP for both states (between 10.0% and 14.2% for State A, and between 19.2% and 23.0% for State B) (Table 2). Information for components of the date of LMP was more likely to be missing from the medical records for State A. For State B, day of LMP was more likely to be missing from the medical records, but month and year of LMP were somewhat more likely to be missing from the birth certificate.

For this study, computation of the recoded items prenatal care beginning in the first trimester and the LMP-based gestational age at delivery require complete information from other date-based items. The first trimester care item requires information on both the complete date of the first prenatal visit and the complete date of LMP; the LMP-based gestational age requires the complete date of LMP and the date of birth. Accordingly, levels of unknown data for these derived items were higher than those for the individual items; see Table 2.

Number of previous cesareans, the obstetric estimate of gestational age, and birthweight—Levels of data missing on either the birth certificate or medical records were low in both states for the number of previous cesareans (0.0% and 0.2%, respectively), the obstetric estimate of gestational age (0.3% and 3.2%), and birthweight (0.2% and 0.4%).

All checkbox items—Levels of data missing on either the birth certificate or medical records were low or negligible in both states and for all of the checkbox items (Table 2). The highest levels of missing data for the checkbox items were found for source of payment (1.0% for State A and 3.8% for State B), infant living at time of report (1.7% for State A and 0.0% for State B), and infant being breastfed at discharge (0.7% for State A and 6.5% for State B).

Evaluation of noncheckbox items

Exact agreement for items on the birth certificate

This report examined patterns of exact agreement for noncheckbox items; see Figure 2 and Table 3. High levels of agreement, of 95% and above, were found for *both* states for several items: number of previous live births now living, number of previous live births now dead, and month last normal menses (LMP) began. (Note, however, substantial levels of missing data for the month of LMP for both states; see Table 2.) Agreement was at least 90% for both states for number of previous cesarean deliveries and birthweight (exact grams).

Agreement was found to be at least substantial (75% or higher) for both states for: month of last live birth (91.4% and 86.9%, respectively), total number of other pregnancy outcomes (83.2% and 86.6%), and month of first prenatal visit (76.6% and 79.6%). Moderate agreement (60.0%–74.9%) was found for both states for the day of the first prenatal visit (71.1% and 66.5%, respectively). (Note levels of missing or not-stated data for the prenatal care items; see Figure 3 and Table 2.)

Agreement between medical records and birth certificate data was less consistent between the two states for several items. For example, agreement for the obstetric estimate of gestation (exact) was high for State A (91.6%), but moderate for State B (67.4%). Similarly, agreement for State A was substantial for the day of LMP (87.4%) and total number of prenatal visits within two visits (84.3%), but moderate for State B (70.1% and 65.0%, respectively). The item with the lowest percentage of exact agreement for both states was the total number of prenatal care visits (47.8% for State A and 22.1% for State B).

Exact agreement for recoded items

Recoding of the continuous variables consistently improved agreement between the birth certificate and the medical records; this

Noncheckbox item	Level of agreement	
	State A	State B
High agreement		
Birthweight (grams)	High	High
Birthweight (within 500 grams)†	High	High
Date last normal menses began (month)	High	High
Number of previous cesarean deliveries	High	High
Number of previous live births now dead	High	High
Number of previous births now living	High	High
Obstetric estimate of gestation (within 2 weeks)†	High	High
Substantial or greater agreement		
Date last normal menses began (day within 2 weeks)†	High	Substantial
Date of last live birth (month)	High	Substantial
Date last normal menses began (day)	Substantial	Moderate
Date of first prenatal care visit (month)	Substantial	Substantial
Total number of other pregnancy outcomes	Substantial	Substantial
Other combinations		
Date of last prenatal care visit (month)	High	Moderate
Obstetric estimate of gestation at delivery (exact)	High	Moderate
Total number of prenatal care visits (within 2 weeks)†	Substantial	Moderate
Date of first prenatal care visit (day)	Moderate	Moderate
Date of last other pregnancy outcome (month)	Moderate	Low
Date of last prenatal care visit (day)	Substantial	Extremely low
Low or extremely low agreement		
Total number of prenatal care visits	Low	Extremely low

† Recoded item.
NOTE: Levels of agreement within states are defined as follows: high (90.0%–100.0%), substantial (75.0%–89.9%), moderate (60.0%–74.9%), low (40.0%–59.9%), and extremely low (less than 40.0%).
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 2. Noncheckbox items, by level of agreement

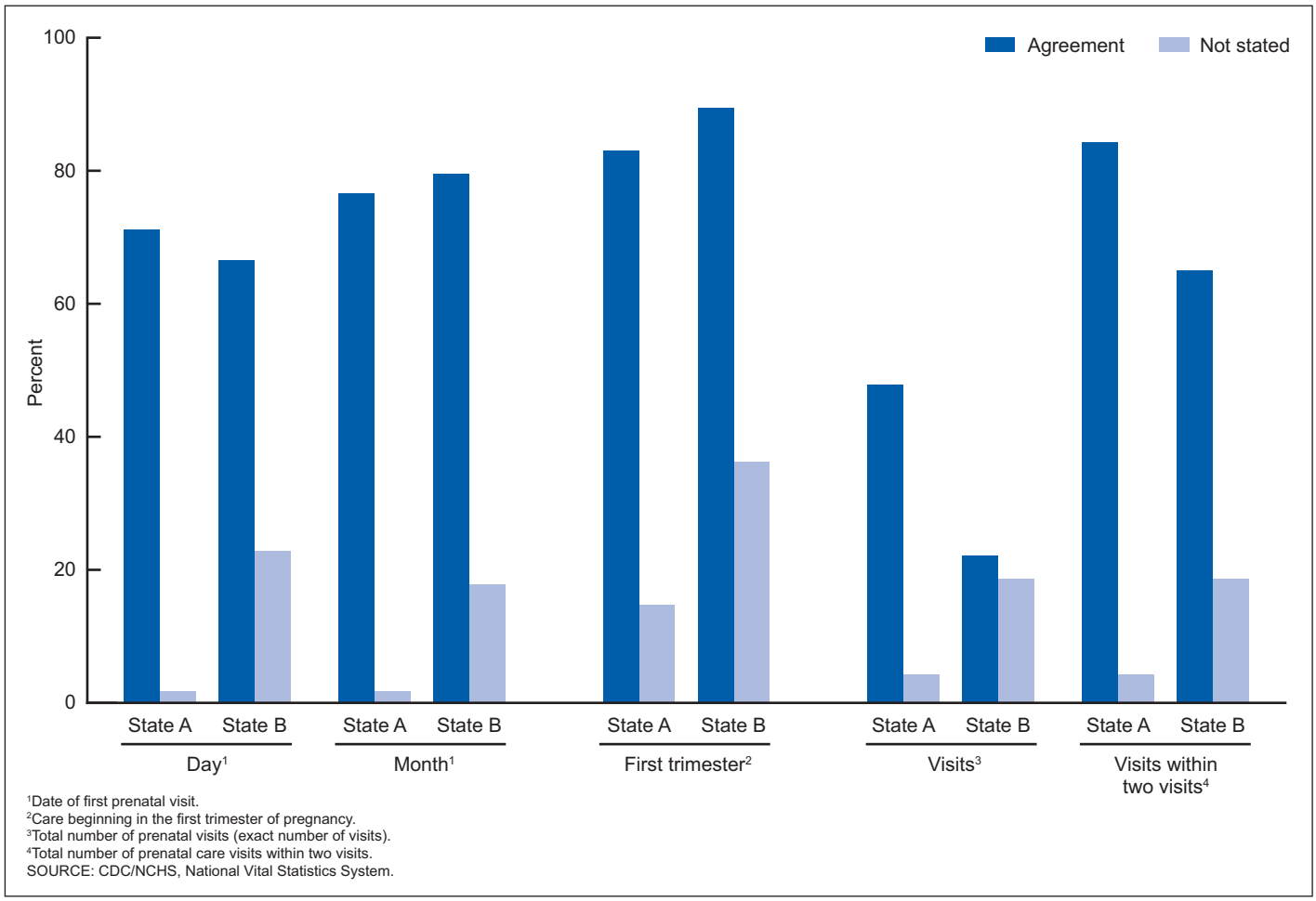


Figure 3. Agreement and not stated for prenatal care items for states A and B

effect was particularly evident for the prenatal care items (Figure 3 and Table 3). (See also "Missing data.") Whereas agreement for the month and day of the first prenatal visit ranged from 66.5% to 79.6% for the two states, agreement for the derived item first trimester prenatal care rose to 83.0% for State A and 89.5% for State B. Agreement for the total number of prenatal visits was low or extremely low in both states (47.8% and 22.1%), but agreement for total number of prenatal visits within two visits was 84.3% and 65.0%, respectively.

Recoding also improved agreement levels for the detailed obstetric estimate of gestation and birthweight items. Agreement for the obstetric estimate of gestation (exact weeks) was 91.6% for State A and 67.4% for State B, but increased to 99.7% and 98.1% when recoded to estimate of gestation within 2 weeks. Recoding of detailed obstetric estimate to "percent preterm" resulted in agreement levels of 95.3% and 72.5%. Similarly, collapsing birthweight in exact grams to "percent low birthweight" raised agreement from about 90% to over 95% in both states.

Evaluation of checkbox items

Agreement and Cohen's kappa scores

Agreement between the birth certificate and medical records (i.e., condition reported and condition not reported) for the checkbox items ranged from 64.7% to 99.7% in State A and from 69.9% to 98.8% in State B; about two-thirds of all items for both states had agreement levels of at least 90% (Table 4). Kappa scores were substantial or high for both states (0.61 or greater) for: previous cesarean delivery, vaginal or spontaneous delivery, cesarean delivery, attempted trial of labor, private insurance, and Medicaid. Kappa scores of 0.40 or less, suggesting slight to fair agreement, were observed for both states for: previous preterm birth, meconium staining, and fetal intolerance of labor. Results for a number of items differed quite widely by state; items with the largest differences in kappa scores between states were: infant living at time of report (State A kappa = 0.85; State B kappa = 0.36), premature rupture of membranes (0.60 and 0.21, respectively), and antibiotics received by the newborn (0.79 and 0.04).

Sensitivity rates

Among checkbox items, rates of sensitivity were high and above 95% in both states for: cephalic presentation, vaginal delivery, and infant living. Levels were above 90% in both states for cesarean delivery (97.9% for State A and 91.8% for State B) and infant breastfed at discharge (90.7% and 96.2%, respectively) (Figures 1 and 4, and Table 4). Sensitivity levels were substantial or greater in both states for: epidural or spinal anesthesia (96.1% for State A and 85.4% for State B) and private insurance (82.3% and 85.8%,

Checkbox item	Level of sensitivity	
	State A	State B
High sensitivity		
Infant living at time of report	High	High
Method of delivery—Cesarean	High	High
Fetal presentation—Cephalic	High	High
Method of delivery—Vaginal or spontaneous	High	High
Infant breastfed at discharge	High	High
Substantial or greater sensitivity		
Epidural or spinal anesthesia during labor	High	Substantial
Source of payment—Private insurance	Substantial	Substantial
Other combinations		
NICU admission	High	Low
Trial of labor attempted	Substantial	Moderate
Mother had a previous cesarean delivery	Substantial	Moderate
Source of payment—Medicaid	Substantial	Moderate
Induction of labor	Substantial	Low
Antibiotics received by the newborn for suspected neonatal sepsis	Substantial	Extremely low
Augmentation of labor	Moderate	Extremely low
Assisted ventilation immediately after delivery	Moderate	Extremely low
Antibiotics received by the mother	Moderate	Extremely low
Low or extremely low sensitivity		
Diabetes—Gestational	Low	Low
Premature rupture of the membranes	Low	Extremely low
Hypertension—Gestational	Low	Extremely low
Precipitous labor	Low	Extremely low
Moderate or heavy meconium staining	Extremely low	Extremely low
Previous preterm birth	Extremely low	Extremely low
Fetal intolerance of labor	Extremely low	Extremely low

NOTES: Levels of agreement within states are defined as follows: high (90.0%–100.0%), substantial (75.0%–89.9%), moderate (60.0%–74.9%), low (40.0%–59.9%), and extremely low (less than 40.0%). NICU is neonatal intensive care unit.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 4. Checkbox items, by level of sensitivity

respectively). Levels were at least moderate in both states for trial of labor (88.5% and 74.4%), previous cesarean delivery (82.1% and 62.5%), and Medicaid (79.0% and 72.6%).

Differences in sensitivity levels for several items varied widely between states. For example, the sensitivity level for induction of labor was substantial in State A, at 86.0%, but low in State B, at 45.9%; the sensitivity level for antibiotics received by the mother was moderate in State A, at 61.4%, and extremely low in State B, 36.7%.

A number of items had low sensitivity levels across both states [e.g., gestational diabetes (57.7% in State A and 58.6% in State B)]; or low sensitivity in one state and extremely low sensitivity in the other [e.g., premature rupture of the membranes (56.3% and 15.8% respectively), and gestational hypertension (50.0% and 20.0%, respectively)]. (Note that the latter percentage may not be reliable because the numerator is based on fewer than five records.) Sensitivity was extremely low (less than 40%) in both states for three checkbox items—previous preterm birth, moderate or heavy meconium staining, and fetal intolerance of labor; levels for fetal intolerance were below 20% in both states.

False discovery rates

Because of the small numbers for some items, information on false discovery rates was available only for a limited number of variables (Table 4). FDRs, as with the other measures, varied by item and by state. For example, the FDR for private insurance was 27.9% in State A compared with 4.4% in State B. FDRs for Medicaid were 7.0% and 8.2% for States A and B, respectively. Items with fairly low FDRs of less than 6% for both states were: previous cesarean delivery (fewer than five records in numerator for both states), vaginal or spontaneous delivery, cesarean delivery, and infant living (Figure 5). Three items had moderate to high FDRs between 15% and 44% in both states: gestational diabetes, infant breastfed, and trial of labor; two of these items—infant breastfed and trial of labor—also had moderate to high rates of sensitivity; see Figure 6. FDRs for fetal intolerance were the highest reported across both states (80.4% in State A and 64.3% in State B); this item also had one of the lowest sensitivity rates for both states (Table 4).

Exact agreement and sensitivity by state

Exact agreement and sensitivity levels were generally higher for State A than for State B for most items. Among State A's non-checkbox items, 11 were classified as "high agreement" compared with 7 items for State B (Figure 2). Thirteen checkbox items were classified as high or substantial sensitivity for State A compared with seven items for State B (Figures 3 and 4, and Table 4). Generally, scores for specific items were fairly similar between states, that is, an item with a high score in State A generally had a high or substantial score in State B. For example, exact agreement for number of previous cesareans was 95.3% in State A and 92.5% in State B; sensitivity percentages for epidural or spinal anesthesia were 96.1% (State A) and 85.4% (State B) (Figure 1, Table 3).

Several items had widely different levels of agreement or sensitivity by state: day of last prenatal visit (79.5% for State A compared with 37.2% for State B), induction of labor (86.0% and 45.9%), NICU (neonatal intensive care unit) admission (95.1% and 45.1%), and antibiotics received by newborn (77.5% and 1.9%; latter percentage may not be reliable; numerator based on 5 or less).

Exact agreement and sensitivity by hospital

Agreement was high or substantial among each of the eight hospitals (four in each state) examined for several of the non-checkbox items: number of previous live births now living, number of previous births now dead, month of last live birth, number of previous cesareans, month of LMP, and birthweight (exact grams) (Table 5). A number of items were less consistently reported across hospitals. For example, the level of exact agreement for day of first prenatal visit ranged from 21.1% to 93.2% (six of the eight hospitals showed moderate agreement or higher for this item). Agreement levels for the number of prenatal visits ranged from 4.6% to 69.7% (extremely low levels of agreement were observed for six of the hospitals, and moderate agreement for two hospitals).

Among the limited number (11 total) of checkbox items for which numbers were large enough to calculate reliable rates, sensitivity was high or substantial among all eight hospitals for: cephalic presentation, vaginal or spontaneous delivery, cesarean delivery, infant living, and infant breastfed (Figure 7 and Table 6). Greater variability was seen for other items by hospital. For example, the level of sensitivity for Medicaid ranged from 42.2% to 95.8%, with sensitivity high or substantial for six

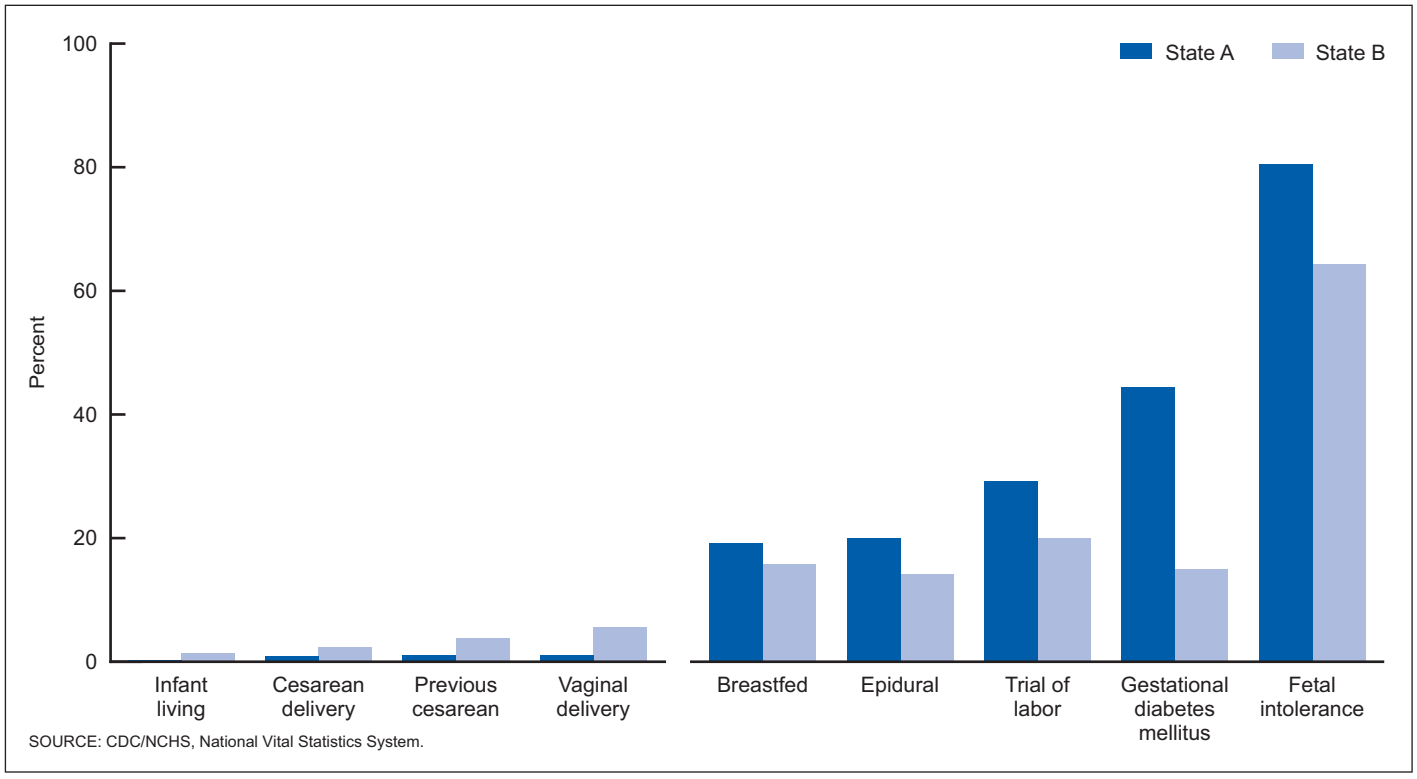
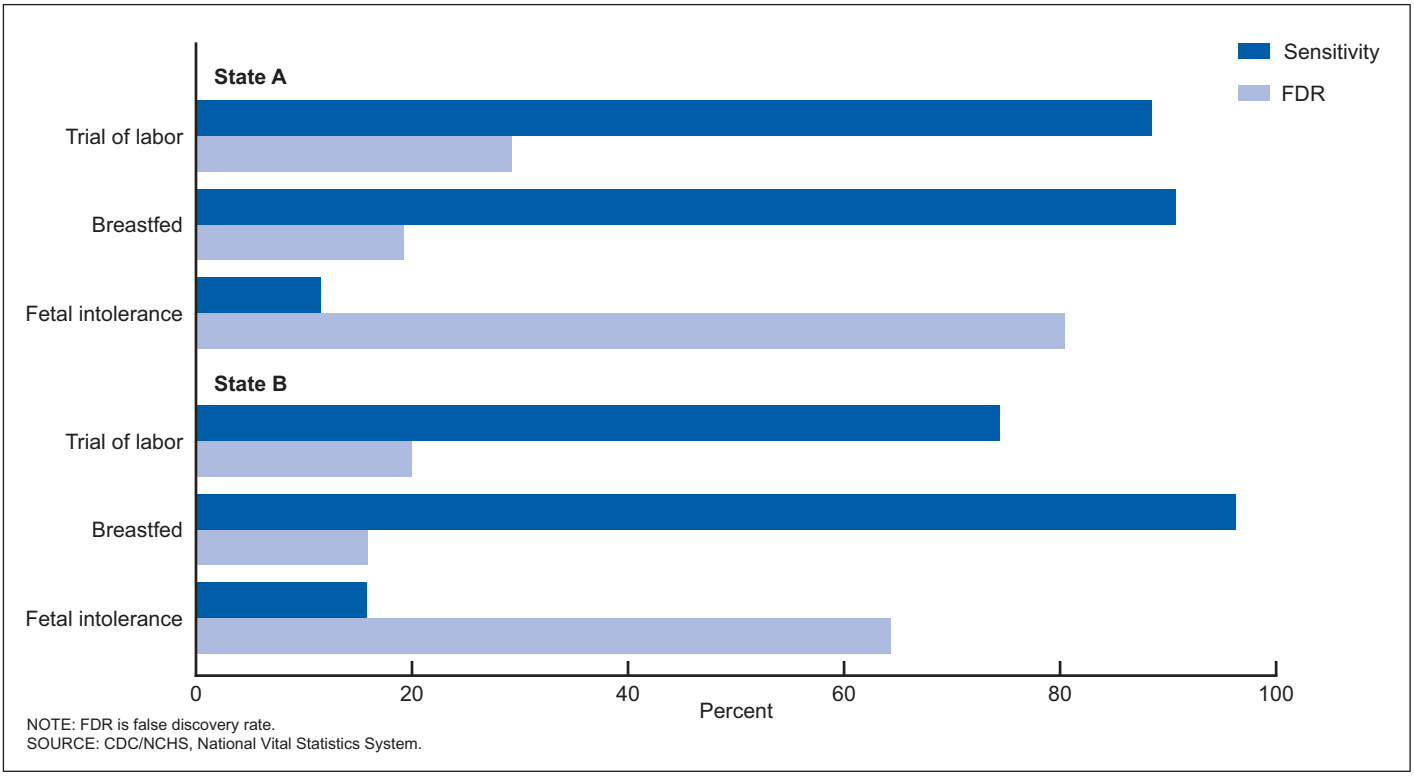
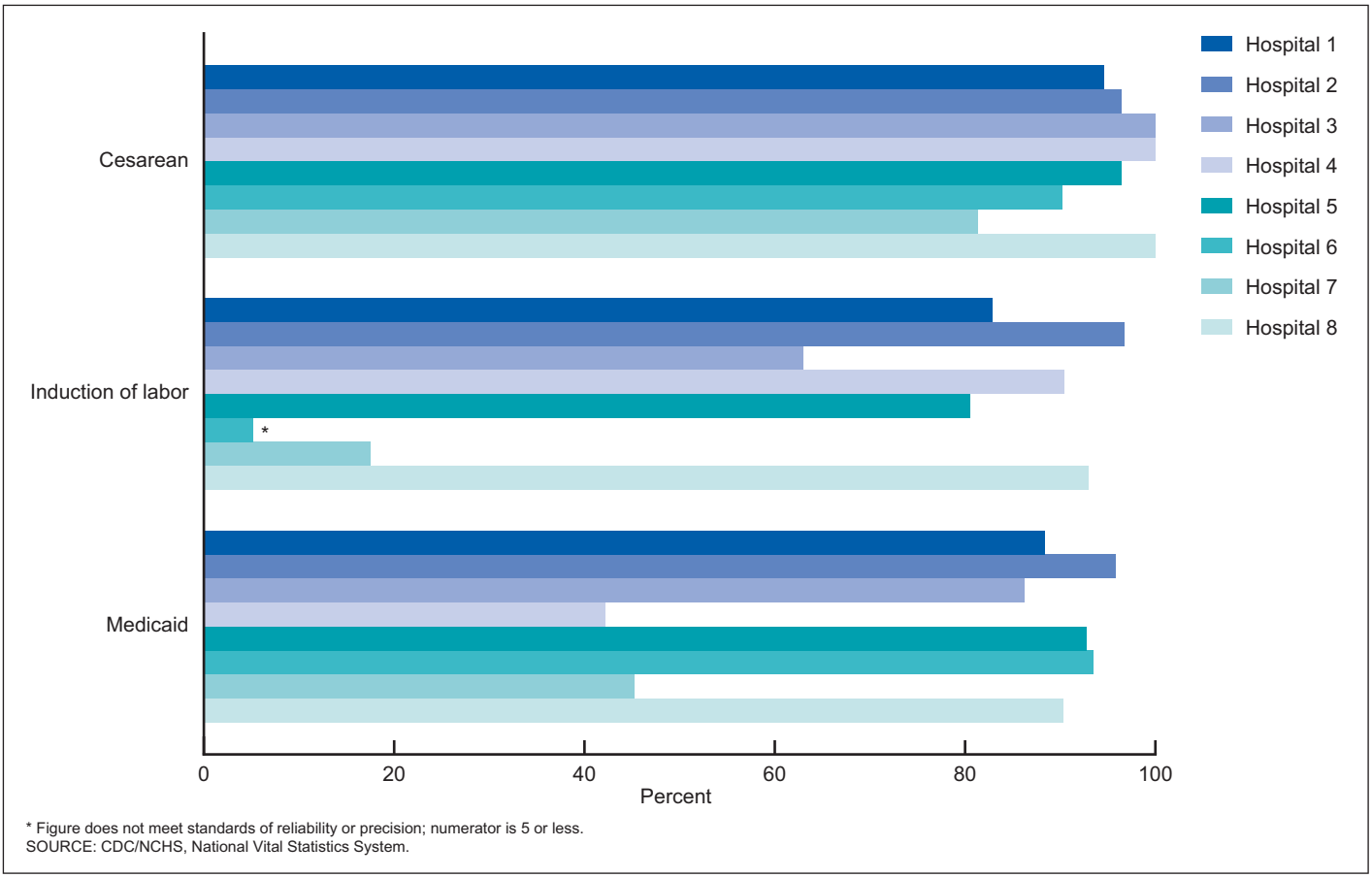


Figure 5. Items with lowest and highest false discovery rates for states A and B



NOTE: FDR is false discovery rate.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 6. Sensitivity and false discovery rates for selected items for states A and B



* Figure does not meet standards of reliability or precision; numerator is 5 or less.
SOURCE: CDC/NCHS, National Vital Statistics System.

Figure 7. Sensitivity for selected checkbox items for states A and B, by hospital

hospitals, but low for the two remaining hospitals; sensitivity for augmentation of labor ranged from 0.0% to 98.0%—three hospitals had sensitivity levels of more than 89.0%, but three hospitals were below 40.0%.

Discussion

This study shows wide variation in the quality of data based on the 2003 revision of the birth certificate. Differences in data quality, as compared with hospital medical records, were evident by item, and often, by state and hospital. Whereas exact agreement for non-checkbox items and sensitivity for checkbox items were high for a number of variables for both states studied (e.g., number of previous cesarean deliveries, birthweight within 500 grams, cephalic presentation, and cesarean delivery), several items (e.g., total number of prenatal visits, previous preterm birth, meconium staining, and fetal intolerance of labor) demonstrated low or extremely low levels of agreement or sensitivity. Levels of agreement or sensitivity for many items (e.g., month of first prenatal visit, induction of labor, and Medicaid), however, fell between these two extremes, indicating some level of underreporting of birth certificate data for a number of health and medical conditions.

Underreporting and misreporting—Underreporting of health conditions is considered a primary limitation of birth certificate data (7,8). Accordingly, the primary statistical measure used in this study to assess underreporting of the categorical variables is sensitivity. Misreporting of information on the birth certificate may also be an issue, however, and FDRs are calculated to assess potential misreporting of the categorical data items. This measure should also be considered to assess the quality of a given checkbox item. Higher-than-expected FDRs, even where sensitivity was moderate to high, may be of concern. For example, the relatively high FDRs for epidural or spinal anesthesia (20% and 14% in State A and State B, respectively), trial of labor (29% and 20%), and breastfeeding (19% and 16%) indicate that this information was more often reported on the birth certificate than in the medical records. This difference suggests that hospital personnel are either misinterpreting the medical records, or they are seeking the information from other sources, (i.e., the mother or other familial informant or clinical staff) (22–25).

Low sensitivity and a high FDR, as seen for fetal intolerance of labor and meconium staining (FDR not available for State B due to the small number of cases), is particularly troubling, and suggests pervasive misreporting for these items. Results for these items and previous preterm birth (FDR not available) strongly suggest that it may not be feasible to collect high-quality data for certain items for the birth certificate. Unfortunately, hospital-specific data, which would lend more definitive evidence on whether these data could be improved, were not available because of the small number of cases. An upcoming larger study should provide further evidence on the potential for improvement for these more problematic items.

Missing data and the use of sources other than the medical record—Although moderate to substantial agreement was found for the components used to measure the timing of prenatal care, it is important to note that the level of unknown values for these items (in both hospital records and on the birth certificate) was high for State B (17.8% for month of first prenatal visit and 22.8% for day of first prenatal visit) (Figure 3); these unknown values weaken the reliability of these data. Similarly, agreement was moderate to substantial for the date of LMP (used to calculate gestational age of the infant), but data were missing for a substantial percentage of records in both states. Substantial levels of missing data may produce bias in the results for these items.

Interviews in 2009 and 2010 with birth information specialists representing 54 hospitals in four states that had implemented the 2003 revision of the birth certificate indicated a continued lack of standardization for collecting birth data across the hospitals (22–25). Most of the medical and health information collected for the birth certificate was gathered by a clinician (more than one-half of the hospitals) or by the birth information specialist using the hospital medical records (26). But the birth information specialists reported that, despite these national standard recommendations, the mother was often the source of the pregnancy history and prenatal care information (41% of hospitals) (22–26). Information from this study supports this finding. That is, the often-higher levels of missing information from the medical records compared with the birth certificates for the pregnancy history, prenatal care, and date of LMP items suggests that a source other than the medical records was used to gather this information for the birth certificate.

A comparison of the number of prenatal visits reported on the birth certificate and in the hospital medical records also suggests that hospital staff may be consulting sources other than the medical records for prenatal care information. These data show a higher number of prenatal care visits was reported on the birth certificate compared with the medical records for State B; results for State A were not statistically significant (Table B).

Differences in results by state—The reasons for the differences in results by state may be partially explained by the hospitals selected for study and the differences in the sampling methods used. State A's sampling technique was more robust (i.e., a random sample compared with a convenience sample) and a larger number of records were reviewed (600 compared with 495). State A's sample included a higher proportion of preterm and low-birthweight births—likely related to the PRAMS sample design, which oversamples for high-risk births (19). Information on mothers and infants with poorer outcomes may be more thoroughly documented (6). State B's sample included higher proportions of births to non-Hispanic black and Hispanic mothers. Underreporting on the birth certificate has been associated with minority status and limited English-language proficiency (6,27). Indeed, unknown levels for birth certificate health data are frequently higher for black and Hispanic mothers; 2010 data for a 33-state reporting area show prenatal care information was more likely to be unknown for non-Hispanic black (8.9%) and Hispanic (4.7%) mothers, compared with white (3.5%) mothers (28).

Table B. Disagreement between the birth certificate and medical records on the total number of prenatal care visits, by state

Characteristic	State A		State B	
	n	Percent	*n*	Percent
Total disagreement[1]	300	100.0	314	100.0
Higher number of visits on birth certificate	160	53.3	221	70.4
Higher number of visits on medical record	140	46.7	93	29.6

[1]Number of records that disagree on the exact total number of prenatal care visits.

Limitations—This study had a number of limitations, including that the use of medical records as the "gold standard" assumes that information in these records is complete. Such may not always be the case, especially for prenatal care information for which records may not always be available or current (22–26). Secondly, small sample sizes did not allow for analysis of all items for both states and all hospitals, and no information was available for a number of the more rarely occurring health items on the birth certificate (e.g., use of infertility therapy, infections during pregnancy, and maternal morbidity). And, as noted earlier, estimates of agreement for the pregnancy history, prenatal care, and gestational age items are compromised by missing data on both the birth certificate and the medical records.

The generalizability of these results is unclear. Hospitals were selected to have varying characteristics, including differences in data quality, but they are not necessarily representative of all hospitals in the state. The study samples generally are not representative of births occurring in the states during the same time period in the states (see Table 1 and "Characteristics of study samples"). Although the two states studied have some years of experience using the 2003 revised birth certificate and tend to experience quality issues common for many states (29), findings for these two areas may not be generalizable to other states and to the national birth data.

Data-quality improvement efforts—This study found that many items with less-than-optimum agreement by state often showed high agreement for one or more hospitals. For example, the level of sensitivity for augmentation of labor was only moderate in State A, and extremely low in State B, but three of the eight hospitals (two in State A and one in State B) showed sensitivity levels of 89% and higher. This finding suggests that quality-improvement efforts could be effective in expanding the number of hospitals with more complete reporting, and that there is the potential for high-quality national data for many birth certificate items that currently appear underreported.

Many data-quality improvement efforts are underway currently. For example, NCHS, NAPHSIS (the National Association for Public Health Statistics and Information Systems), and individual state and jurisdictional vital statistics partners are using multiple strategies to assess and improve the quality of birth data.

NCHS and NAPHSIS are collaborating to develop interactive e-learning training for hospital staff (both birth information specialists and clinical staff) and to promote universal use of the detailed training materials already available. [The study with birth information specialists noted above found that hospital personnel often were unaware of the recommended standard instructions and definitions to complete the birth certificate health information (22–25.)] NCHS and NAPHSIS also are collaborating to develop national standards for the automatic transfer of medical and health birth certificate data directly from the hospital electronic records to state electronic birth registration systems (30) using HL7- (Health Level 7) and IHE- (Integrating the Healthcare Enterprise) based standards; a pilot project is under way.

A new NCHS-NAPHSIS joint committee has been tasked with identifying key birth data quality issues and developing effective approaches to resolving them across the nation. Initial committee objectives include: 1) identifying model reports for state-to-hospital feedback on data quality issues; 2) developing ways to promote hospital understanding of the importance and use of birth data and techniques in order to improve hospital awareness of the uses of birth certificate data; and 3) identifying sources of problems with prenatal care data and developing ways to improve quality.

Also, the American College of Obstetricians and Gynecologists also has recently launched a "revitalize" campaign that may have an important impact on the future quality of birth certificate obstetric data. The campaign goals include national standardization of obstetric clinical data definitions for electronic health records and birth certificates (31). NCHS and NAPHSIS are participating in this effort, and expect to incorporate these definitions for the birth certificate, once finalized.

Finally, NCHS has recently entered into new 5-year contracts with the 57 vital records reporting areas. A central goal of the new contracts is to substantially improve data timeliness and quality via increased standardization, performance requirements, and targeted support for jurisdictions, where needed.

Additional validity studies on birth certificate data will be necessary to confirm the findings of this report and to assess the quality of less frequently occurring events (e.g., the use of infertility therapy, infections during pregnancy, and maternal morbidities) on the birth certificate—information that was not available for this study. The latter analysis may be accomplished via linkages of birth certificate data with other data sources that include comparable data items of interest. For example, linkages between state birth certificate data and ART Surveillance System data can be used to assess the quality of the infertility treatment (32); and linkages with hospital discharge data can be used to evaluate specific maternal risk factors and morbidities (33). Studies also will be needed to assess and improve the effectiveness of the new training tools for hospital personnel, and to carefully examine the new systems being developed for the automatic transfer of data from electronic medical records to electronic birth registration systems.

As these data-quality improvement efforts take hold across the country, NCHS will continue to work with its state and jurisdictional colleagues via efforts such as this study, and through ongoing evaluation of missing data to assess the impact of improved data quality on the incidence of the many birth certificate medical and health items (e.g., prenatal care timing and gestational diabetes). Data from the 2003 birth certificate revision are a reliable source for some health-related data elements, but underreporting of many items continues to be an issue. Although there appear to be several items for which the collection of quality data may not be feasible, most should be responsive to improvement. The quality of these data should rise as more comprehensive improvement efforts take effect. In the interim, understanding and acknowledging the strengths and weaknesses of these data is essential for responsible use.

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List of Detailed Tables

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Table 1. Characteristics of study sample and of all births occurring in each state during the same time period, by selected demographics and health characteristics: State A (2010 and 2011) and State B (2009)

Characteristic of mother	State A sample[1]		Total State A[2]		State B sample[3]		Total State B[4]	
	n	Percent	*n*	Percent	*n*	Percent	*n*	Percent
Race and Hispanic origin								
All races and origins[5]	600	100.00	54,837	100.00	495	100.00	42,515	100.00
Non-Hispanic								
White[6]	369	†61.50	30,300	55.54	257	†51.92	30,194	71.29
Black[6]	180	30.00	17,556	32.18	59	†11.92	3,058	7.22
Hispanic[7]	33	†5.50	4,678	8.56	151	†30.51	6,873	16.20
Age in years								
Under 20	65	10.83	6,369	11.62	59	11.92	4,285	10.08
20–24	163	27.17	15,771	28.77	128	25.86	11,369	26.74
25–29	178	29.67	15,488	28.25	140	28.28	13,227	31.11
30–34	125	20.83	11,345	20.69	118	23.84	9,221	21.69
35–39	52	8.67	4,816	8.78	43	8.69	3,626	8.53
40–54	17	2.83	1,032	1.88	7	1.41	784	1.84
Characteristic of infant								
Preterm[8]	102	†17.00	6,239	11.38	40	8.13	3,933	9.27
Low birthweight[9]	89	†14.83	5,380	9.81	34	6.87	3,141	7.39

† Difference significant at $p = 0.05$.

[1]Random sample of births occurring in State A in four hospitals from October 2010 through March 2011.

[2]All births occurring in State A from July 2010 through June 2011.

[3]Convenience sample of births occurring in State B in four hospitals from September 2009 through November 2009.

[4]All births occurring in State B from January 2009 through December 2009.

[5]Includes other races not shown and origin not stated.

[6]Race and Hispanic origin are reported separately on the birth certificate. Race categories are consistent with the 1997 Office of Management and Budget standards; see reference 28. Data by race are non-Hispanic and exclude mothers reporting multiple races.

[7]Includes all persons of Hispanic origin of any race.

[8]Born prior to 37 completed weeks of gestation.

[9]Birthweight of less than 2,500 grams (5 pounds, 8 ounces).

Table 2. Records for which specified items are not stated, by source and state

Item	State A					State B				
		Number not stated					Number not stated			
	Total records	Medical record	Birth certificate	Both	Percent not stated[1]	Total records	Medical record	Birth certificate	Both	Percent not stated[1]
Noncheckbox items										
Pregnancy history										
Number of previous live births now living	600	6	0	0	1.0	495	3	0	0	0.6
Number of previous live births now dead	600	5	0	0	0.8	495	9	0	0	1.8
Date of last live birth (month)	600	119	44	37	21.0	495	95	14	11	19.8
Date of last live birth (year)	600	21	2	0	3.8	495	41	8	5	8.9
Total number of other pregnancy outcomes	600	4	0	0	0.7	495	4	0	0	0.8
Date of last other pregnancy outcome (month)	600	137	52	48	23.5	495	98	47	34	22.4
Date of last other pregnancy outcome (year)	600	40	8	5	7.2	495	56	15	8	12.7
Prenatal care										
Date of first prenatal care visit (month)	600	10	1	0	1.8	495	55	51	18	17.8
Date of first prenatal care visit (day)	600	10	1	0	1.8	495	57	87	31	22.8
Date of first prenatal care visit (year)	600	10	1	0	1.8	495	55	2	0	11.5
First trimester prenatal care	600	79	23	13	14.8	495	121	124	66	36.2
Date of last prenatal care visit (month)	600	15	1	1	2.5	495	49	6	1	10.9
Date of last prenatal care visit (day)	600	16	1	1	2.7	495	50	13	3	12.1
Date of last prenatal care visit (year)	600	15	1	1	2.5	495	49	0	0	9.9
Total number of prenatal care visits	600	24	1	0	4.2	495	67	34	9	18.6
Number of previous cesarean deliveries	600	0	0	0	0.0	495	1	0	0	0.2
Gestational age										
Date last normal menses began (month)	600	58	12	10	10.0	495	55	68	28	19.2
Date last normal menses began (day)	600	77	26	18	14.2	495	83	68	37	23.0
Date last normal menses began (year)	600	57	13	9	10.2	495	55	68	28	19.2
LMP-based gestation at delivery	600	77	27	18	14.3	495	87	68	38	23.6
Obstetric estimate of gestation at delivery	600	2	0	0	0.3	495	13	3	0	3.2
Birthweight (grams)	600	1	0	0	0.2	495	2	0	0	0.4
Checkbox items										
Pregnancy risk factors	600	0	0	0	0.0	495	0	0	0	0.0
Obstetric procedures	600	0	0	0	0.0	495	0	0	0	0.0
Onset of labor	600	0	0	0	0.0	495	0	0	0	0.0
Source of payment for this delivery	600	0	6	0	1.0	495	2	17	0	3.8
Characteristics of labor and delivery	600	0	0	0	0.0	495	0	0	0	0.0
Fetal presentation at birth	600	0	0	0	0.0	495	7	0	0	1.4
Final route and method of delivery	600	0	0	0	0.0	495	1	0	0	0.2
Abnormal conditions of the newborn	600	0	0	0	0.0	495	0	0	0	0.0
Infant living at time of report	600	10	0	0	1.7	495	0	0	0	0.0
Infant being breastfed at discharge	600	0	4	0	0.7	495	0	32	0	6.5

[1]The percentage of records with a not-stated or missing value for at least one source (the number of not-stated values on the medical record plus the number of not-stated values on the birth certificate, minus the number of not-stated values on both, per the total number of records).

NOTE: LMP is last normal menses.

Table 3. Exact agreement for noncheckbox items, by state

Noncheckbox item	State A (*n* = 600) Exact agreement		State B (*n* = 495) Exact agreement	
	Number[1]	Percent	Number[1]	Percent
Pregnancy history				
Number of previous live births now living	570 / 594	96.0	473 / 492	96.1
Number of previous live births now dead	590 / 595	99.2	476 / 486	97.9
Date of last live birth (month)	212 / 232	†91.4	185 / 213	†86.9
Total number of other pregnancy outcomes	496 / 596	83.2	425 / 491	86.6
Date of last other pregnancy outcome (month)	36 / 58	†62.1	27 / 47	†57.4
Prenatal care				
Date of first prenatal care visit (month)	451 / 589	76.6	324 / 407	†79.6
Date of first prenatal care visit (day)	419 / 589	71.1	254 / 382	†66.5
First trimester prenatal care[2]	308 / 371	†83.0	214 / 239	†89.5
Date of last prenatal care visit (month)	543 / 585	92.8	329 / 441	†74.6
Date of last prenatal care visit (day)	464 / 584	79.5	162 / 435	†37.2
Total number of prenatal care visits	275 / 575	47.8	89 / 403	†22.1
Total number of prenatal care visits (within two visits)[2]	485 / 575	84.3	262 / 403	†65.0
Number of previous cesarean deliveries	572 / 600	95.3	457 / 494	92.5
Gestational age				
Date last normal menses began (month)	520 / 540	†96.3	381 / 400	†95.3
Date last normal menses began (day)	450 / 515	†87.4	267 / 381	†70.1
Percent preterm (LMP-based)[2]	91 / 96	†94.8	31 / 43	†72.1
Date last normal menses began (day within two visits)[2]	464 / 515	†90.1	313 / 381	†82.2
Obstetric estimate of gestation at delivery (exact weeks)	548 / 598	91.6	323 / 479	67.4
Percent preterm (Obstetric estimate-based)[2]	101 / 106	95.3	37 / 51	72.5
Obstetric estimate of gestation (within 2 weeks)[2]	596 / 598	99.7	470 / 479	98.1
Birthweight (exact grams)	539 / 599	90.0	447 / 493	90.7
Birthweight within 500 grams[2]	597 / 599	99.7	490 / 493	99.4
Percent low birthweight[2]	88 / 92	95.7	33 / 33	100.0
Percent very low birthweight[2]	59 / 59	100.0	*	*

† Level of missing or unknown values greater than 5%.

* Figure does not meet standards of reliability or precision.

[1]Number of records for which value on birth certificates and medical records agree, per total records.

[2]Recoded item.

NOTE: LMP is last normal menses.

Table 4. Agreement, Cohen's kappa, sensitivity, and false discovery rates for selected checkbox items, by state

Checkbox item	State A (*n* = 600)							State B (*n* = 495)						
	Exact agreement		Kappa	Sensitivity		False discovery rate		Exact agreement		Kappa	Sensitivity		False discovery rate	
	Number[1]	Percent		Number BC/MR[2]	Percent	Number[3]	Percent	Number[1]	Percent		Number BC/MR[2]	Percent	Number[3]	Percent
Pregnancy risk factors														
Diabetes—Gestational	577 / 600	96.2	0.55	15 / 26	57.7	12 / 27	44.4	480 / 495	97.0	0.68	17 / 29	58.6	3 / 20	**15.0
Hypertension—Prepregnancy	576 / 600	96.0	0.50	13 / 33	39.4	*	*	488 / 495	98.6	*	*	*	*	*
Hypertension—Gestational	548 / 600	91.3	0.50	32 / 64	50.0	20 / 52	38.5	468 / 495	94.5	**0.24	5 / 25	**20.0	*	*
Previous preterm birth	554 / 600	92.3	0.29	11 / 50	22.0	*	*	467 / 495	94.3	0.31	7 / 34	20.6	*	*
Mother had a previous cesarean delivery	579 / 600	96.5	0.88	92 / 112	82.1	1 / 93	**1.1	463 / 495	93.5	0.72	50 / 80	62.5	2 / 52	**3.8
Obstetric procedures														
Tocolysis	552 / 600	92.0	**0.07	2 / 49	**4.1	*	*	485 / 495	98.0	*	*	*	*	*
Onset of labor														
Premature rupture of the membranes	578 / 600	96.3	0.60	18 / 32	56.3	8 / 26	30.8	457 / 495	92.3	0.21	6 / 38	15.8	*	*
Precipitous labor	584 / 600	97.3	*	*	*	*	*	466 / 495	94.1	**0.09	2 / 23	**8.7	*	*
Source of payment for this delivery														
Private insurance	499 / 594	84.0	0.65	158 / 192	82.3	61 / 219	27.9	435 / 476	91.4	0.83	194 / 226	85.8	9 / 203	4.4
Medicaid	503 / 594	84.7	0.70	267 / 338	79.0	20 / 287	7.0	408 / 476	85.7	0.70	146 / 201	72.6	13 / 159	8.2
Self-pay	586 / 594	98.7	*	*	*	*	*	438 / 476	92.0	0.60	34 / 45	75.6	27 / 61	44.3
Other	559 / 594	94.1	0.71	51 / 58	87.9	28 / 79	35.4	425 / 476	89.3	*	*	*	*	*
Characteristics of labor and delivery														
Induction of labor	538 / 600	89.7	0.78	185 / 215	86.0	32 / 217	14.7	411 / 495	83.0	0.52	68 / 148	45.9	4 / 72	**5.6
Augmentation of labor	504 / 600	84.0	0.66	179 / 257	69.7	18 / 197	9.1	346 / 495	69.9	0.33	77 / 207	37.2	19 / 96	19.8
Steroids for fetal lung maturation prior to delivery	554 / 600	92.3	0.55	33 / 78	42.3	1 / 34	**2.9	482 / 495	97.4	*	*	*	*	*
Antibiotics received by the mother during labor	471 / 600	78.5	0.52	135 / 220	61.4	44 / 179	24.6	400 / 495	80.8	0.44	54 / 147	36.7	2 / 56	**3.6
Moderate or heavy meconium staining	561 / 600	93.5	0.28	9 / 28	32.1	20 / 29	69.0	451 / 495	91.1	0.26	9 / 50	18.0	*	*
Fetal intolerance of labor	388 / 600	64.7	–0.06	18 / 156	11.5	74 / 92	80.4	388 / 495	78.4	0.11	15 / 95	15.8	27 / 42	64.3
Epidural or spinal anesthesia during labor	479 / 600	79.8	0.40	416 / 433	96.1	104 / 520	20.0	403 / 495	81.4	0.59	274 / 321	85.4	45 / 319	14.1
Fetal presentation at birth														
Cephalic	552 / 600	92.0	0.42	531 / 544	97.6	35 / 566	6.2	455 / 488	93.2	0.34	445 / 464	95.9	14 / 459	3.1
Breech	589 / 600	98.2	0.74	16 / 24	66.7	*	*	478 / 488	98.0	*	*	*	*	*
Final route and method of delivery														
Vaginal or spontaneous	576 / 600	96.0	0.92	311 / 319	97.5	16 / 327	4.9	470 / 494	95.1	0.88	339 / 343	98.8	20 / 359	5.6
Vaginal or vacuum	583 / 600	97.2	0.76	29 / 40	72.5	6 / 35	17.1	488 / 494	98.8	*	*	*	*	*
Cesarean	593 / 600	98.8	0.97	228 / 233	97.9	2 / 230	**0.9	480 / 494	97.2	0.93	123 / 134	91.8	3 / 126	**2.4
Trial of labor attempted[4]	203 / 228	89.0	0.71	46 / 52	88.5	19 / 65	29.2	104 / 123	84.6	0.66	32 / 43	74.4	8 / 40	20.0

See footnotes at end of table.

Table 4. Agreement, Cohen's kappa, sensitivity, and false discovery rates for selected checkbox items, by state—Con.

Checkbox item	State A (*n* = 600)							State B (*n* = 495)						
	Exact agreement		Kappa	Sensitivity		False discovery rate		Exact agreement		Kappa	Sensitivity		False discovery rate	
	Number[1]	Percent		Number BC/MR[2]	Percent	Number[3]	Percent	Number[1]	Percent		Number BC/MR[2]	Percent	Number[3]	Percent
Abnormal conditions of the newborn														
Assisted ventilation immediately after delivery	566 / 600	94.3	0.66	38 / 55	69.1	17 / 55	30.9	467 / 495	94.3	**0.23	5 / 26	**19.2	*	*
Assisted ventilation more than 6 hours	583 / 600	97.2	0.81	39 / 49	79.6	7 / 46	15.2	483 / 495	97.6	*	*	*	*	*
NICU admission	586 / 600	97.7	0.90	77 / 81	95.1	10 / 87	11.5	449 / 495	90.7	0.57	37 / 82	45.1	1 / 38	**2.6
Newborn given surfactant replacement therapy	581 / 600	96.8	0.79	40 / 49	81.6	10 / 50	20.0	485 / 495	98.0	*	*	*	*	*
Antibiotics received by the newborn	574 / 600	95.7	0.79	55 / 71	77.5	10 / 65	15.4	442 / 495	89.3	**0.04	1 / 54	**1.9	*	*
Infant living at time of report	588 / 590	99.7	0.85	583 / 583	100.0	2 / 585	**0.3	488 / 495	98.6	0.36	486 / 486	100.0	7 / 493	1.4
Infant breastfed at discharge	483 / 596	81.0	0.58	332 / 366	90.7	79 / 411	19.2	394 / 463	85.1	0.63	304 / 316	96.2	57 / 361	15.8

* Figure does not meet standards of reliability or precision.

** Figure may not be reliable; numerator is 5 or less.

[1]Number of records for which value on birth certificates and medical records agree, per total records.

[2]Number of records where the condition was indicated on both the birth certificate (BC) and the medical record (MR), per the total number the condition was indicated on the medical records.

[3]Number of records the condition was indicated on the birth certificate, but not on the medical records per the total number the condition was indicated on the birth certificate.

[4]Only includes births for which both the medical record and birth certificate agree that a cesarean delivery was performed.

NOTE: NICU is neonatal intensive care unit.

Table 5. Exact agreement for noncheckbox items, by state and hospital

Noncheckbox item	State A								State B							
	Hospital															
	1		2		3		4		5		6		7		8	
	n = 150		*n* = 150		*n* = 150		*n* = 150		*n* = 124		*n* = 123		*n* = 123		*n* = 125	
	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent	Number[1]	Percent
Pregnancy history																
Number of previous live births now living	144 / 148	97.3	143 / 148	96.6	146 / 150	97.3	137 / 148	92.6	121 / 124	97.6	115 / 122	94.3	118 / 122	96.7	119 / 124	96.0
Number of previous live births now dead	149 / 149	100.0	148 / 150	98.7	147 / 148	99.3	146 / 148	98.6	122 / 123	99.2	117 / 120	97.5	117 / 120	97.5	120 / 123	97.6
Date of last live birth (month)	57 / 61	93.4	76 / 83	91.6	28 / 29	96.6	51 / 59	86.4	39 / 40	97.5	45 / 58	77.6	45 / 50	90.0	56 / 65	86.2
Total number of other pregnancy outcomes	104 / 149	69.8	133 / 150	88.7	145 / 150	96.7	114 / 147	77.6	115 / 124	92.7	100 / 123	81.3	97 / 120	80.8	113 / 124	91.1
Prenatal care																
Date of first prenatal care visit (month)	141 / 148	95.3	146 / 150	97.3	124 / 144	86.1	40 / 147	27.2	97 / 114	85.1	85 / 116	73.3	46 / 61	75.4	96 / 116	82.8
Date of first prenatal care visit (day)	138 / 148	93.2	137 / 150	91.3	113 / 144	78.5	31 / 147	21.1	84 / 104	80.8	53 / 116	45.7	34 / 48	70.8	83 / 114	72.8
First trimester prenatal care	82 / 90	91.1	89 / 92	96.7	83 / 90	92.2	54 / 99	54.5	59 / 65	90.8	82 / 92	89.1	26 / 30	86.7	47 / 52	90.4
Date of last prenatal care visit (month)	140 / 148	94.6	141 / 150	94.0	119 / 140	85.0	143 / 147	97.3	89 / 115	77.4	79 / 117	67.5	70 / 91	76.9	91 / 118	77.1
Date of last prenatal care visit (day)	125 / 148	84.5	121 / 150	80.7	97 / 139	69.8	121 / 147	82.3	44 / 114	38.6	12 / 117	10.3	46 / 86	53.5	60 / 118	50.8
Total number of prenatal care visits	99 / 142	69.7	47 / 150	31.3	89 / 136	65.4	40 / 147	27.2	37 / 108	34.3	5 / 108	**4.6	21 / 74	28.4	26 / 113	23.0
Number of previous cesarean deliveries	147 / 150	98.0	136 / 150	90.7	147 / 150	98.0	142 / 150	94.7	122 / 124	98.4	108 / 123	87.8	106 / 122	86.9	121 / 125	96.8
Gestational age																
Date last normal menses began (month)	124 / 129	96.1	137 / 141	97.2	125 / 129	96.9	134 / 141	95.0	101 / 102	99.0	107 / 116	92.2	82 / 86	95.3	91 / 96	94.8
Date last normal menses began (day)	115 / 128	89.8	118 / 132	89.4	114 / 124	91.9	103 / 131	78.6	85 / 100	85.0	49 / 107	45.8	53 / 83	63.9	80 / 91	87.9
Obstetric estimate of gestation at delivery	134 / 150	89.3	128 / 149	85.9	140 / 149	94.0	146 / 150	97.3	80 / 124	64.5	78 / 112	69.6	99 / 121	81.8	66 / 122	54.1
Birthweight (grams)	134 / 150	89.3	137 / 150	91.3	136 / 149	91.3	132 / 150	88.0	113 / 123	91.9	116 / 123	94.3	96 / 122	78.7	122 / 125	97.6

** Figure may not be reliable; numerator is 5 or less.

[1]Number of records for which value on birth certificates and medical records agree, per total records.

Table 6. Sensitivity for selected checkbox items, by state and hospital

Checkbox item	State A								State B							
	Hospital															
	1		2		3		4		5		6		7		8	
	n = 150		*n* = 150		*n* = 150		*n* = 150		*n* = 124		*n* = 123		*n* = 123		*n* = 125	
	Number BC/MR[1]	Percent	Number BC/MR[1]	Percent	Number BC/MR[1]	Percent	Number BC/MR[1]	Percent	Number BC/MR[1]	Percent	Number BC/MR[1]	Percent	Number BC/MR[1]	Percent	Number BC/MR[1]	Percent
Source of payment for this delivery																
Private insurance	42 / 50	84.0	20 / 24	83.3	37 / 53	69.8	59 / 65	90.8	54 / 56	96.4	85 / 89	95.5	11 / 35	31.4	44 / 46	95.7
Medicaid	38 / 43	88.4	113 / 118	95.8	81 / 94	86.2	35 / 83	42.2	51 / 55	92.7	29 / 31	93.5	38 / 84	45.2	28 / 31	90.3
Characteristics of labor and delivery																
Induction of labor	63 / 76	82.9	58 / 60	96.7	17 / 27	63.0	47 / 52	90.4	33 / 41	80.5	2 / 39	**5.1	7 / 40	17.5	26 / 28	92.9
Augmentation of labor	96 / 98	98.0	30 / 33	90.9	17 / 27	63.0	36 / 99	36.4	43 / 89	48.3	0 / 32	0.0	1 / 49	**2.0	33 / 37	89.2
Antibiotics received by the mother during labor	35 / 46	76.1	40 / 67	59.7	58 / 74	78.4	2 / 33	**6.1	43 / 56	76.8	0 / 32	0.0	0 / 39	0.0	11 / 20	55.0
Epidural or spinal anesthesia during labor	90 / 91	98.9	110 / 123	89.4	119 / 120	99.2	97 / 99	98.0	95 / 103	92.2	84 / 86	97.7	53 / 79	67.1	42 / 53	79.2
Feral presentation at birth																
Cephalic	140 / 140	100.0	137 / 146	93.8	111 / 114	97.4	143 / 144	99.3	119 / 120	99.2	112 / 112	100.0	110 / 110	100.0	104 / 122	85.2
Final route and method of delivery																
Vaginal or spontaneous	67 / 72	93.1	81 / 84	96.4	72 / 72	100.0	91 / 91	100.0	90 / 90	100.0	73 / 76	96.1	87 / 87	100.0	89 / 90	98.9
Cesarean	53 / 56	94.6	54 / 56	96.4	76 / 76	100.0	45 / 45	100.0	27 / 28	96.4	37 / 41	90.2	26 / 32	81.3	33 / 33	100.0
Infant living at time of report	149 / 149	100.0	143 / 143	100.0	145 / 145	100.0	146 / 146	100.0	123 / 123	100.0	121 / 121	100.0	121 / 121	100.0	121 / 121	100.0
Infant being breastfed at discharge	97 / 109	89.0	72 / 74	97.3	69 / 78	88.5	94 / 105	89.5	73 / 77	94.8	81 / 86	94.2	76 / 78	97.4	74 / 75	98.7

** Figure may not be reliable; numerator is 5 or less.

0.0 Quantity more than zero but less than 0.05.

[1]Number of records where the condition was indicated on both the birth certificate (BC) and the medical record (MR), per the total number the condition was indicated on the medical records.

Technical Notes

Table. Item title key

Full item name	Abbreviated item name
Total number of prenatal care visits for this pregnancy	Number of prenatal care visits
Last normal menses	LMP
Mother had a previous cesarean delivery—if yes, how many?	Number of previous cesarean deliveries
Diabetes—Gestational	Gestational diabetes or Diab—Gestational
Hypertension—Gestational	Gestational hypertension or Hyper—Gestational
Previous preterm birth	Previous PTB
Mother had a previous cesarean delivery	Previous cesarean
Premature rupture of the membranes (prolonged more than 12 hours)	Premature rupture of the membranes (PROM)
Precipitous labor (less than 3 hours)	Precipitous labor
Principal source of payment for this delivery—Private insurance	Private insurance or Private ins
Principal source of payment for this delivery—Medicaid	Medicaid
Principal source of payment for this delivery—Self-pay	Self-pay
Principal source of payment for this delivery—Other	Other
Augmentation of labor	Augmentation
Steroids (glucocorticoids) for fetal lung maturation received by the mother prior to delivery	Steroids for fetal lung maturation prior to delivery
Antibiotics received by the mother during labor	Antibiotics—Mother
Moderate or heavy meconium staining of the amniotic fluid	Moderate or heavy meconium staining, meconium or meconium staining
Fetal intolerance of labor was such that one or more of the following actions was taken: in-utero resuscitative measure, further fetal assessment, or operative delivery	Fetal intolerance of labor or fetal intolerance
Epidural or spinal anesthesia during labor	Epidural or anesthesia, or epidural
Fetal presentation at birth—Cephalic	Cephalic
Fetal presentation at birth—Breech	Breech
Final route and method of delivery—Vaginal or spontaneous	Vaginal or spontaneous, or vaginal
Final route and method of delivery—Vaginal or vacuum	Vaginal or vacuum
Final route and method of delivery—Cesarean	Cesarean
If cesarean, was a trial of labor attempted?	Trial of labor attempted, trial of labor, or TOL
Assisted ventilation required immediately following delivery	Assisted ventilation immediately after delivery or assisted ventilation
Assisted ventilation required for more than 6 hours	Assisted ventilation more than 6 hours
Neonatal intensive care unit	NICU
Antibiotics received by the newborn for suspected neonatal sepsis	Antibiotics received by the newborn or antibiotics—Newborn
Is infant living at time of report?	Infant living
Is infant being breastfed at discharge?	Breastfed or infant breastfed

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES

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National Vital Statistics Reports, Vol. 62, No. 2, July 22, 2013

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Acknowledgments

The authors gratefully acknowledge Charles J. Rothwell, Acting Director of the National Center for Health Statistics (NCHS); Delton Atkinson, Acting Director of NCHS' Division of Vital Statistics (DVS); and Stephanie J. Ventura, Chief of DVS' Reproductive Statistics Branch for their support of this project. The authors also acknowledge Paul D. Sutton and Steven J. Steimel of DVS, Greg Crawford and Carol Moyer of the Kansas Department of Health and Environment, and Daniela Nitcheva of the South Carolina Department of Health and Environmental Control for their work in fielding this study and creating the data files; and they acknowledge Meena Khare and Diba Khan of NCHS' Office of Research and Methodology, and Sally Curtin and Marie Thoma of DVS for statistical guidance. This report was edited and produced by CDC/OSELS/NCHS/OD/Office of Information Services, Information Design and Publishing Staff: Danielle Woods edited the report; typesetting was done by Jacqueline M. Davis; and graphics were produced by Ryan M. Dumas (contractor).

Suggested citation

Martin JA, Wilson EC, Osterman MJK, et al. Assessing the quality of medical and health data from the 2003 birth certificate revision: Results from two states. National vital statistics reports; vol 62 no 2. Hyattsville, MD: National Center for Health Statistics. 2013.

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DHHS Publication No. 2013–1120 • CS241230