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SPECIAL FEATURE

History of the birth certificate: from inception to the future of electronic data

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Enumerations of people were carried out long before the birth of Jesus. Data related to births were recorded in church registers in England as early as the 1500s. However, not until the 1902 Act of Congress was the Bureau of Census established as a permanent agency to develop birth registration areas and a standard registration system. Although all states had birth records by 1919, the use of the standardized version was not uniformly adopted until the 1930's. In the 1989 US Standard Birth Certificate revision, the format was finally uniformly adopted to include checkboxes to improve data quality and completeness. The evolution of the 12 federal birth certificate revisions is reflected in the growth of the number of items from 33 in 1900 to more than 60 items in the 2003 birth certificate. As birth registration has moved from paper to electronic, the birth certificate's potential utility has broadened, yet issues with updating the electronic format and maintaining quality data continue to evolve. Understanding the birth certificate within its historical context allows for better insight as to how it has been and will continue to be used as an important public-health document shaping medical and public policies.

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Introduction

Birth registration is one of the foundations of public health. Understanding data surrounding live births may affect clinical practice, health policies and efficient resource allocation. Hetzel[1] reviewed the history of vital statistics in 1997 before many electronic advances and before the latest 2003 revision of the birth certificate. We believe exploring the historical evolution of the birth certificate will allow medical and health policy analysts to better plan future directions.

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The inception of birth registration

Public health statistics have come to be regarded as an indispensable tool for proper planning, management and evaluation of many health programs. The compilation of vital statistics is of ancient origin. Before the birth of Jesus, counting and characterization of populations were undertaken, notably in the Old Testament, China, Egypt, Persia, Greece and Rome. The primary purposes were for taxation and determination of available military manpower. Data related to births were recorded in elementary form in church registers in England as early as the 1500s.

Early American colonists who came from England were accustomed to the recording of church-related events such as christenings. Therefore, in 1632 the Grand Assembly of Virginia legally convened an annual presentation of these events, which translated into recording births to insure individual rights, primarily for property. In 1639, Massachusetts took the next step requiring the government to record these vital events rather than clergy recording baptisms.[1]

The 1800s led to high rates of immigration to the Northeastern US. Urban dwellers, especially the poor, lived in crowded and unsanitary conditions, exacerbated by pollution produced by rapid industrialization. In response, sanitary reformers used scientific approaches to develop data-driven solutions, thereby emphasizing the importance of collecting systematic vital records of births and deaths.[1] Furthermore, birth registration could be used to monitor public health interventions.[2]

The prototype for American state-based registration was created after a cholera epidemic engulfed England and Wales prompting British reforms such as the maintenance of vital records through a single office in 1836. This stimulated the first American State registration law enacted in Massachusetts in 1842. The American Medical Association (AMA) then supported the movement toward better vital records by creating a committee to analyze methodology of vital records registration in 1846. However, even as other states or cities followed suit, no uniformity of data collection was put in place.[1]

The movement toward a national clearinghouse for state and city data evolved through the US Bureau of the Census. The Census

Act of 1840 created a centralized Census Office for the gathering of national statistics in a uniform manner. In March 1849, the census board was designated by Congress to guide the census timing and utilize standard forms.[3] The first standard certificates for the registration of live births were developed in 1900 by the Bureau of the Census. A 1902 Act of Congress that established the Bureau of Census as a permanent agency of the federal government included a provision giving the agency statutory authority for the development of registration areas for births. The Bureau of the Census undertook to develop a system for the annual collection of vital statistics that would produce nationally comparable data.[1]

The Bureau of the Census retained the authority for producing national vital statistics until 1946, when the function was transferred to the US Public Health Service as the National Office of Vital Statistics.[1,4] It was then reorganized in 1963 as the Division of Vital Statistics of the National Center for Health Statistics (NCHS).[1] The National Vital Statistics System is the basis for the Nation's official statistics on births, deaths, fetal deaths, marriages and divorces. The US Standard Certificates and Reports are among the principal means by which uniformity of data collection and processing is achieved.

From 1915 to 1933, national birth registration areas in the US progressed from 10 states and the District of Columbia to all the states except for Alaska and Hawaii, which started reporting births upon becoming states in 1959.[5] Although all states had birth records by 1919, the use of the standardized version was not uniformly adopted until the 1930s.[6] During World War II, the importance of birth registration was emphasized as it became proof of citizenship, which was needed to become eligible for employment.[1,7] Thus, the birth certificate became a legal document used for determining citizenship, as well as an important source of perinatal epidemiology.[5,6]

Today, through the work of NCHS, there is a common national standard birth certification, which individual states can supplement.[4] Vital statistics for the US are collected and published through a decentralized, cooperative system, not solely from a central federal entity, leading to differences in the kinds of data and how they are collected in different states. The responsibility for registration of births is vested in the individual States and certain independent geographic city registration areas. The federal government then utilizes the data not only to understand health issues and publish national statistics, but also to evaluate health and welfare programs. Hence, it has heightened the importance of maintaining quality vital statistics.[1]

Alterations in the content and format of the birth certificate

The birth certificate has been revised about every 10 years with 12 revisions since 1900.[1,8] The evolution of the birth certificate is reflected in the growth of the number of items from 33 in 1900 to more than 60 items in 2003[4](see Table 1).

Initially, content of the birth certificate primarily included the date and address of birth, whether there was a multiple gestation, mother's age and race, legitimacy, paternal name and age, and previous live births. Data were captured through an open-ended format. However, there was a growing need for 'Simplicity in wording… attractiveness and convenience in arrangement, spacing, and print' as noted by W A Plecker in 1915.[9] He recommended changes including 'the need for the term 'Boy or Girl,'

Table 1 Key changes in the data captured by the birth certificate from early 1900s to 2003

Key changes in the data captured by the birth certificate from early 1900's through 2003	
Early 1900's	•Content primarily related to the date and address of birth, whether there was a multiple gestation, mother's age and race, legitimacy, paternal name and age, previous live births
1949	•Birth weight and length of pregnancy were added
1968	•Dating of the pregnancy based on last menstrual period (LMP) was added as the 1960's saw the birth of the field of Neonatology •Inclusion of questions on prenatal care
1979	•Changed to collecting the mother's marital status, dropping the more judgmental "legitimate" • Apgar scores were added, 26 years after Virginia Apgar developed the test to assess the health of newborn babies • Terminations of pregnancy (spontaneous or induced) were added as induced abortions became legalized in January of 1973 (Roe v Wade)
1989	•Clinical estimation of gestational age, maternal medical risk factors, whether the mother and father were of Hispanic origin, smoking and alcohol use, as well as methods and complications of delivery and obstetrical procedures •First use of checklists
2003	•More details on smoking (by trimester), obesity (before/after pregnancy weight and height), infertility (fertility treatments or ART), nutrition (use of WIC program, breastfeeding at discharge), and maternal morbidities related to labor/delivery (such as transfusion and ruptured uterus)

Abbreviations: ART, assisted reproductive technology; WIC, the Special Supplemental Nutrition Program for Women, Infants and Children.

instead of 'Sex'…' and 'in answer to the inquiry as to *color*, we got numerous replies, such as 'brunette,' 'blond,' 'light skinned,' 'dark,' etc. The change to *Color* or *Race* (was instituted and with) the joint use of the two terms, results are satisfactory.'[9]

Between 1930 and 1955 information relating to stillbirth was included. Thereafter, the Report of Fetal Death was used, separating live births from stillbirths. Starting in 1930, infants were noted to be either full-term or premature. The 1939 revision switched to recording months of pregnancy. In 1949, this was then changed to completed weeks along with adding birth weight.[1] The checkbox format was suggested by Lilienfeld *et al*.[10] in 1951 to address issues of under-reporting and accuracy of birth certificates.

The 1968 revision added maternal and paternal education, complications of pregnancy and labor, and congenital malformations.[1] Dating of the pregnancy based on last menstrual period (LMP) was also added,[1] as the 1960s saw the birth of the field of Neonatology.[11] The death of President Kennedy's son at 34 to 35 weeks in 1963 due to respiratory distress syndrome was felt to be an impetus for research dollars contributing to development of the field.[12]

The 1979 birth certificate revision brought the switch to mother's marital status instead of the more judgmental 'legitimate'.[1] Apgar scores were added 26 years after Virginia Apgar published the score to assess the health of newborn babies.[1,11] Maternal history of pregnancy terminations, whether spontaneous or induced, were added after induced abortions became legalized in January 1973.[1]

The check box format began to be adopted by a few states in the early 1980s.[13,14] In the 1989 US Standard Birth Certificate revision, the format was finally uniformly adopted to include checkboxes to improve data quality and completeness.[14] Before 1989, the infant's race was tabulated based on parental race. If the race of both parents were not the same, the infant was assigned to the non-white parent race. Alternatively, if both parents were non-white, then the infant would be assigned to the father's race. Following the 1989 revision, the mother's race was used for tabulation as well as capturing parental ethnicity. This revision also incorporated risk factors such as smoking, alcohol use, methods and complications of delivery, and clinical gestational age, reflected by obstetric exam and ultrasound.[1] Nevertheless, to this day, measurement of gestational age remains controversial.[15]

The mechanism for recording data on paper was constant even as the content of birth registration evolved. The paper medium for birth registration was felt to be responsible for significant delays in data reporting (1 to 3 years), leading to reduced utility. Thus, the electronic birth certificate was created in California in 1980, and by the beginning of 1991, 20 states had adopted an electronic birth certificate.[16]

Most recently, the latest 2003 revision has added fields, which facilitate monitoring of relevant public health trends. More detail on smoking is now assessed by trimester, including the 3 months before pregnancy. Furthermore, the rising issue of obesity is better delineated through more detailed data collection of pre-pregnancy weight, weight and height at delivery, and pre-pregnancy versus gestational-related diabetes and hypertension.[17] Also added was whether the pregnancy resulted from treatment of infertility, participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), and breastfeeding at discharge. Although, infections during the pregnancy were added, HIV was not among the list. For quality assurance purposes, maternal morbidities related to labor and delivery, such as transfusion and ruptured uterus, were added.[4]

Since 2003, source of payment for delivery is now captured, which could further clarify issues related to the ongoing national health coverage debates. This is also the first time that mothers and fathers may identify themselves with more than one race, consistent with changes in the Census. Further discussion of reporting of race on the birth certificate is beyond the scope of the present paper, but the reader can refer to technical notes[18] for further review of the critical issues. The 2003 revision includes efforts to improve quality of data through new standard worksheets, one for the mother and one for the facility, insuring capturing the data from optimal sources. The worksheets include more specific definitions, as well as mechanisms to double check data upon entry.[4,17]

Although all states now have electronic systems, many systems are over 20-years old, and not all states have incorporated the 2003 revisions.[17,19] In fact, at the end of 2010, 15 registration areas out of 50 states and two cities (Washington, DC and New York City) had not adopted the 2003 format (Charles J Rothwell, MS, MBA, Director, Division of Vital Statistics, NCHS, CDC, Personal Communication, 1/5/11). Many states are in various stages of addressing these concerns through revising their original systems with the ultimate goal of standardizing the birth certificate electronic systems. The aim is to improve efficiency and accuracy through interfacing with other systems such as newborn screening and automatically extracting clinical data from the mother's electronic medical record.[19,20]

History of data quality of the birth certificate

The fields of public health and epidemiology have been coterminous with the refinement of vital statistics. However, despite strides in the collection of birth registration data, the quality of this data has been a serious issue, which will be discussed below.

Information type

As noted above, in the 1950s, issues with under-reporting were noted with regard to pregnancy or labor complications.[10] Information was more precise if readily available at or near the time of delivery. The authors also found that the more serious the complication, the more likely it was to be reflected accurately.[10]

Although there were significant improvements over time, underreporting remained a concern. When comparing prenatal records, hospital records and birth certificate data, Dobie *et al*.[21] demonstrated a range in degree of missing birth certificate data from 0% for the item related to prior live births, to 24% for data on LMP.

Roohan *et al*. found birth certificate validity in comparison with medical records differed in sensitivity. For example, the date of first prenatal visit within a day was correct for 71% of certificates, whereas number of prenatal care visits were accurate 59% within one visit and 70% within two visits.[22] The authors suggested that higher accuracy was related to, 'increased standardization of medical records, education of medical and non-medical personnel involved in the birth certificate data collection, and quality assurance checks developed within hospitals throughout the state.'[22]

Population disparities

In the past, various high-risk populations have been identified as less likely to have births registered. Shapiro noted a differential in birth registration completeness, which decreased over time between white (94% vs 98.5%, 1940 vs 1950, respectively) and non-white (82% vs 93.4%, 1940 vs 1950, respectively) births.[7] Additionally, the authors identified socioeconomic status as a risk factor for decreased registration such that 'fully a fifth of the babies born to mothers with little or no education were not registered.'[7] Initiatives to improve registration included targeting and educating these high-risk groups.[7]

Higher rates of missing data have also been associated with high-risk populations. Gould *et al*.[23] examined links between missing data on the birth certificate and risk for infant death. Of 538 945 Californian birth certificates reviewed, 7.25% had missing data, more commonly in women at high risk of poor prenatal outcomes such as African Americans, Hispanics, foreign born mothers, maternal age extremes (teen or >40 years), and those mothers with less than a high-school education. Additionally, missing data was more likely to occur if the infant died within the first 24 h.[23]

Data collection and entry

The 1900 Bureau of the Census survey demonstrated that the party responsible for completion of the birth certificate was a major contributing factor to the quality of the data.[24] This survey noted that missing data or poor quality data 'is attributed to the 'negligence', 'unwillingness', 'failure', 'indifference', etc., of physicians.'[24] In response, the AMA in 1903 highlighted 'the important duty of… physicians individually to endeavor to promote the accuracy and value of such statistics whenever they are collected.'[24] Along these lines, identifying and communicating the importance and utility of birth certificate data has been an ongoing strategy to motivate proper data collection.[10]

By the 1950 birth registration completeness test, physicians had significantly improved their registration rates, but this varied by in hospital or home birth. Shapiro found that in 1950 in the Continental US, if a physician was in attendance at the birth in a hospital, there was 99.4% registration, but only 90.6% for physicians not in hospitals; they found a registration rate of 84.5% for midwives, relatives or neighbors.[7] Similarly, Lilienfeld *et al*.[10] noted that accuracy related to which staff completed the certificate; the most accurate were done by the physician, the lowest by a 'resident physician or interne,' with the nurse's rate in between.

In order to realize the great potential utility of birth certificate information today, the accuracy and completeness of the data must be raised. Crucial to raising such rates, there is a need to examine which personnel are responsible for data collection, how missing data is handled, and how data entry and collection staffs are trained. We would argue that understanding the practice of data gathering and recording is crucial to enhancing the use of birth certificate information in both research and clinical practice.

Woolbright[25] noted potential factors affecting data in their study of Alabama birth certificates '…in many States, no systematic effort has been made to distribute these (standard) definitions to physicians or medical records clerks; nor has training been provided in how to recognize and report these items.' For improvement, they suggested '…physicians need to be convinced that the accurate indication of these conditions on the birth certificate is important in providing data for public health researchers and in improving the health of mothers and babies…The medical portion of the certificate needs to be filled out from data provided by both the attending physician and the pediatrician who examines the baby (instead of the clerk or someone not involved with the delivery).'[25]

Northam *et al*.[8] in 2003 described differences in methodology employed in collecting birth certificate data for five hospitals. The persons responsible for data collection, some with data training and others without, varied from untrained clerks to nurses, and in one case, physicians. In four of the five hospitals, no physician participation was involved in the collection or review of the data. The one hospital with physician involvement also had nurses collecting data to improve data quality.[8]

Data quality remains an issue, despite improvements. The study of data quality itself remains fraught with methodological issues, including the generalizability of results due to small populations in many studies. We would assert that, owing to the need for high-quality data to inform public health decisions, staff should be trained to properly utilize existing tools such as standardized worksheets in a reliable manner. Technological advances such as ongoing web-based training sessions could provide a low cost means to accomplish this goal.

Summary

The birth certificate is a living organism that matures and evolves. It has undergone many changes over time. In addition to its

demographic importance, birth certificate data are an important source of information for researchers, policy makers and state officials to evaluate quality of care being delivered to pregnant women. Advances in technology have allowed for linkages of administrative data to other sources of information including Medicaid, death certificates and other publically funded programs like WIC and food stamps. With the increased use of administrative data to evaluate and improve the quality of care, the need to insure accuracy and completeness is essential. With the advent of a universal electronic format of the birth certificate, there are more opportunities to improve data quality, especially through standardized worksheets and web-based training programs. Furthermore, as electronic linkages are created among birth certificates, medical records, and other databases such as newborn screening, medical treatment for individuals will be optimized. In addition, better public health decisions can be made to improve populations' well-being. The economic challenges that we as a nation are now facing may result in a push to postpone improvements to vital statistics. Nevertheless, with history as our guide, we can see that without such reliable high-quality data, we cannot use our resources wisely. As in 1908, complete and accurate birth certificate data contribute materially 'to the importance of vital statistics for the advancement of medical science.'[24]

Conflict of interest

The authors declare no conflict of interest.

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