

## Completeness and Accuracy of Reporting of Malformations on Birth Certificates

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**B**IRTH CERTIFICATES are sometimes used as sources of information in epidemiologic research. Their efficiency in terms of providing records of large numbers of cases at low cost is beyond dispute; their reliability in terms of completeness and accuracy of recorded medical and health information is uncertain and, therefore, often mistrusted.

### Background and Purpose

The Epidemiology Branch of the Division of Dental Health, Public Health Service, in its National Cleft Lip and Palate Intelligence Service, uses birth certificates for studies of clefts and other congenital malformations. In this study an attempt was made to assess how faithfully the data recorded on birth certificates reflect the inci-

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dence of congenital malformations diagnosed in newborn infants. Two elements of the problem were investigated using hospital records as a standard. Completeness of reporting was measured by the number and types of malformations reported on the birth certificates, and accuracy was evaluated by the specificity and fidelity of language describing the conditions. Another purpose of this study was to analyze selected variables that may be related to the completeness of congenital malformation reporting on birth certificates.

Assessing completeness and accuracy of congenital malformations reported on birth certificates is a fundamental component of a larger study of congenital malformations in births that occurred in Iowa in 1963. Additional reasons for undertaking the study were discussed in a previous report (1).

### Survey of Literature

Several investigators have attempted to measure the completeness of reporting congenital malformations on birth certificates compared with hospital records. These investigations (2-7), shown in table 1, were restricted to only a few hospitals in a particular area or to the identification of certain selected malformations. Underreporting of malformations in widely varying degrees is clearly evident.

Employing a slightly different approach, Osterud and co-workers (8) discovered that congeni-

tal heart disease was noted on only half the birth certificates of infants who died from this cause before 2 days of age, well within the birth registration time limit. Hospital records were undoubtedly available to the physicians who signed the birth certificates.

The evaluation of accuracy in the reporting of congenital malformations on birth certificates is difficult. Many researchers express dissatisfaction with the quality of medical and health data, but the accuracy of reported data is difficult to measure. Each investigator must establish his own standards for the agreement of entries on the birth certificate with entries on other documents. Non-standardization of definitions and terminology handicaps such an analysis.

Oppenheimer and co-workers (5) grouped malformations by body system. Matched birth certificates and hospital records revealed discrepancies in both sources. In five malformations studied by Bock and Zimmerman (6), the most easily recognized malformations showed the closest agreement with the hospital records. Ivy (9, 10), while noting underreporting of cleft lip and cleft palate when compared with his other sources, observed that inaccuracies of birth certificate reporting of congenital malformations result from vagueness and careless terminology for the condition described. Osterud and co-workers (8) investigated the accuracy of birth and death certificates as sources of data for the study of congenital defects. Among 358 birth certificates mentioning congenital defects, 14 defects were mistakenly recorded. Seven of these errors appeared on birth certificates as congenital heart disease when the entry should have been respiratory disease.

This investigation was planned to overcome

some of the limitations of previous studies. By surveying all malformations reported in the State of Iowa, it was hoped that the number of records examined would be sufficiently large to determine the degree of completeness and accuracy of malformation data reported on birth certificates.

## Materials and Methods

The hospital records of 57,909 infants born in 144 Iowa hospitals in 1963 were reviewed for diagnoses of congenital malformations of any type. These records represented 98.8 percent of the 58,583 live births registered in the State that year. The infants not represented in the study were those not born in participating hospitals or those whose hospital records were unavailable. If a reference to a congenital malformation was found, the hospital record was abstracted. Records of 5,471 infants were abstracted for the study. Congenital malformations and other selected data were coded and keypunched after careful editing.

The birth certificate of each of the infants whose hospital record was reviewed was also examined for any entry in the item "Describe any congenital malformation." Each malformation and selected nonmedical items were coded and keypunched. Not included in the study were malformations found on the birth certificates of 32 infants whose hospital records could not be located.

Malformations were coded according to a modification of "A Classification of Congenital Malformations" (11), developed earlier to meet the needs of the Congenital Anomalies Section of the Epidemiology Branch. The modification consists of a two-digit malformation code with a third digit

**Table 1. Summary of literature on the completeness of reporting congenital malformations on birth certificates compared with hospital records**

Principal investigator	Number of hospitals	Location	Total malformations	Percent reported on birth certificates
Milham (1963).....	3	Upstate New York.....	<sup>1</sup> 117	67
Lilienfeld (1951).....	6	Upstate New York.....	41	32
Montgomery (1962).....	16	San Francisco.....	92	14
Oppenheimer (1957).....	10	District of Columbia.....	17	53
Bock and Zimmerman (1967).....	236	Pennsylvania.....	<sup>2</sup> 206	63
Babbott and Ingalls (1962).....	1	Urban Pennsylvania.....	<sup>3</sup> 39	44
Babbott and Ingalls (1962).....	1	Upstate Pennsylvania.....	<sup>3</sup> 47	79

<sup>1</sup> Clefts only.

<sup>2</sup> Imperforate anus, omphalocele, tracheo-esophageal fistula, diaphragmatic hernia, and intestinal obstruction only.

<sup>3</sup> Anencephaly, cleft lip and palate, mongolism, spina bifida, and tracheo-esophageal fistula only.

SOURCES: References 2-7.

for specificity. This code provided the necessary detail for comparisons of specific malformations.

Characteristics of malformations that may be related to the completeness and accuracy of malformation reporting on birth certificates were studied in two ways. A panel of pediatricians provided assistance in the development of scales that assigned ratings of severity and ease of recognition to each malformation cataloged in the "Iowa Study Classification of Congenital Malformations." Malformations that are incapacitating or fatal were considered to be major (code 1). Minor malformations were judged to be less serious and often correctable (code 2). Insignificant malformations are deviations from normal that were not considered to have medical significance (code 3). The category of "insignificant" included such entries as phimosis, tongue-tie, and small birthmarks. About 45 percent of the abstracted malformations were classified as insignificant.

The criteria for establishing a 5-grade scale to designate ease in recognizing malformations at birth were as follows:

- A—cannot be missed
- B—seldom missed
- C—easily found if searched for
- D—requires thorough examination
- E—requires unusual alertness, experience, or diagnostic aids.

In the two sets of keypunched cards (birth certificate and hospital record), each malformation was punched on a separate card; therefore, infants with multiple malformations had as many cards in each deck as they had reported malformations. Coded data were then matched and summary cards prepared.

All anomalies of major and minor severity that were recorded on hospital records were examined to test the possible influences of certain variables on the completeness of reporting of congenital malformations on birth certificates. Infant-related variables of interest were birth weight, length of gestation, sex, survival at discharge, autopsy status, and plurality. Parent-related variables were age of mother, age of father, race of mother, race of father, previous deliveries of the mother, and whether the mother was or was not a private patient. Month and day of week of birth (Monday–Thursday, Friday, Saturday–Sunday, and holidays) were also considered.

The variables were examined, and the chi-square method was applied to each of them to test the null hypothesis that the malformations re-

ported on birth certificates and those not reported came from the same population. The 0.05 probability level was chosen.

Malformations that were not entered on hospital records could not have been reported on birth certificates—except in those few instances when a physician knew about a child's condition, but had not yet recorded the information on the medical record. The periods of natal hospitalization varied, as did the number of days between birth and the preparation of the newborn's birth certificate. The intervals between the medical recording of the malformation and the day the physician signed the birth certificate were examined to determine the maximum number of malformations that could have been reported on birth certificates. So far as possible the date of the first entry for each malformation was ascertained. The coding procedure by which this information was compiled, however, was not completely effective. Imprecise diagnoses mentioned early in a hospital record but later recorded in more specific terms were coded according to the date of specific diagnosis. This practice, plus a number of undated diagnoses, made impossible the determination of a precise number of malformations known to physicians before they signed birth certificates of children with malformations.

Following are the percentages of malformations entered on the hospital records in relation to the signing of birth certificates.

Type of malformation	On or before birth certificate signed	After birth certificate signed	Unknown
Major.....	78.2	12.8	9.0
Minor.....	80.6	10.8	8.6
Insignificant.....	72.9	14.9	12.2

The sizable component in the "unknown" column demonstrates the weakness in using hospital recordkeeping systems for this type of analysis. Totals for several malformations reported on birth certificates were greater than the number of hospital entries dated by the time the birth certificates were signed. This discovery indicates that many undated entries must have been written before the birth certificates were signed. All malformations recorded in the hospital during the infants' initial admissions were, therefore, the standard by which completeness of reporting was measured. Included were 1,068 major malformations, 2,501 minor malformations, and 2,948 anomalies judged to be of no significance.

Major and minor malformations in categories

of most complete reporting were examined to determine the accuracy with which they were reported on birth certificates.

## Findings

**Completeness.** There was more complete reporting of major malformations on birth certificates than of minor defects. Table 2 shows the completeness of reporting of major and minor malformations on birth certificates according to severity and ease of recognition. About 39 percent of major malformations were reported, more than four times as frequently as minor malformations. Insignificant anomalies, not included in the table, were almost completely ignored. Malformations that were most easily recognized were reported more completely on birth certificates than were less obvious conditions. Malformations of major severity ranged from 75.9 percent for recognition grade A to 21.8 percent for recognition grade E, and malformations of minor severity from 18.1 percent for recognition grade B to 7.7 percent for recognition grade E. No minor malformations were assigned grade A.

That the physician, in performing examinations of newborns, should record major and easily recognized congenital malformations in the hospital records is not surprising. That these defects were more often transferred to birth certificates than were less severe or less easily recognized anomalies

**Table 2. Malformations entered on hospital records reported on birth certificates according to severity and ease of recognition**

Severity of malformations and ease of recognition	Total	Reported on birth certificates	
		Number	Percent
Major.....	1,068	413	38.7
A—cannot be missed.....	58	44	75.9
B—seldom missed.....	170	122	71.8
C—easily found if searched for.....	394	142	36.0
D—requires thorough examination.....	281	69	24.6
E—requires unusual alertness, diagnostic aids.....	165	36	21.8
Minor.....	2,501	236	9.4
B—seldom missed.....	370	67	18.1
C—easily found if searched for.....	449	54	12.0
D—requires thorough examination.....	1,540	104	6.8
E—requires unusual alertness, diagnostic aids.....	142	11	7.7
Total, major and minor....	3,569	649	18.2

**Table 3. Severity of malformations reported on birth certificates, by severity recorded on hospital records, in percentages**

Severity of malformations on hospital records	Severity of malformations reported on birth certificates				
	Major only	Major and minor	Minor only	Insignificant only	None reported
Major only.....	43	1	3	0	53
Major and minor..	30	13	4	0	53
Major, minor, and insignificant....	30	0	0	0	70
Major and insignificant.....	23	0	8	0	69
Minor only.....	2	0	9	( <sup>1</sup> )	89
Minor and insignificant.....	( <sup>1</sup> )	0	5	( <sup>1</sup> )	94
Insignificant only..	( <sup>1</sup> )	0	( <sup>1</sup> )	( <sup>1</sup> )	99

<sup>1</sup> Less than 1.

alies indicates selective judgment on the part of the attending physician.

The hospital record is more than a document for recording information about individual malformations. Each record represents a child with a constellation of medical observations about him. Table 3 shows how selection operated when children had various combinations of major, minor, and insignificant anomalies. Again, the major malformations were reported on the birth certificates in preference to the reporting of malformations of lesser degrees of severity. Birth certificates of children whose hospital records contained both major and minor or insignificant malformations nearly always had only the major malformations recorded, or none at all.

Desire to confirm a diagnosis is undoubtedly a factor in incomplete reporting of some malformations. For example, an attending physician may prefer to wait several days to observe certain signs indicative of a heart defect or a clubfoot, until a transient condition could be distinguished from a true congenital malformation before making a definitive entry in the hospital record, whereas birth registration procedures discourage delay in completing the certificate.

The null hypothesis was that completeness of reporting malformations is independent of birth weight, length of gestation, sex, survival at discharge, performance of autopsy, plurality, age of mother, age of father, race of mother, race of father, number of previous deliveries of mother, mother's patient status, and month or day of week of birth. Chi-square tests were performed to test

the association between each of these 14 variables and the reporting of major and of minor malformations. None of the variables showed an association with the reporting of minor malformations, and only two—performance of autopsy and patient status of mother—demonstrated an association with the reporting of major malformations.

A greater number of major malformations than expected were reported on birth certificates of children who died before discharge but were not autopsied than was noted on the certificates of children who were autopsied ( $X^2 = 10.25$  D.F. = 1,  $P = < 0.05$ ). Some malformations causing death would have been so obvious—*anencephaly*, for example—that no autopsy would be required. The results of autopsies when they were performed would seldom have been available to the physicians before they signed the birth certificates, although the complete hospital records for these babies would have been included in this study. The performance of an autopsy, therefore, does not have a meaningful relationship with the reporting of malformations on birth certificates.

Major malformations of children whose mothers were private patients were reported more completely than malformations of children whose mothers were not private patients ( $X^2 = 27.75$ , D.F. = 1,  $P = < 0.01$ ). Two-thirds of malformations of infants whose mothers were not private patients were recorded at one hospital. The birth certificates from that hospital were so much less complete with respect to malformations than

certificates from other hospitals where nonprivate patients were delivered that the observed relationship between patient status and reporting must be considered spurious.

The ease of recognition of malformations was not controlled in this analysis and might have had considerable influence on the test results, especially when the autopsy variable was considered.

*Accuracy.* Among the birth certificate entries were some that could be classified as describing accurately the child's condition as recorded on his hospital chart, others were in general agreement with the hospital diagnosis, and still others were ill-defined or nonspecific entries. If the entries were ill defined or nonspecific, they were designated as "poorly defined." As an example, a hospital-recorded cleft lip and palate could have been reported on the birth certificate as cleft lip and palate (accurate), as cleft lip (in general agreement), or as facial deformity (poorly defined).

Groups of malformations that were reported most completely on birth certificates were examined to ascertain the accuracy with which they were reported. Table 4 shows the distribution of each of the diagnoses of selected malformations on hospital records according to the accuracy with which they were reported on birth certificates. Overall, 72.2 percent of the selected malformations were reported accurately, but there were variations from 25 to 100 percent among these groups of malformations. Clefts of the lip or palate were reported on birth certificates with consid-

**Table 4. Distribution of selected malformations showing accuracy of reporting on birth certificates**

Malformation and code <sup>1</sup>	Total on hospital records	Reported on birth certificates			
		Total	Number accurate	General agreement	Poorly defined
Cleft lip (10.0-10.9).....	33	25	23	2	0
Cleft lip and palate (11.0-11.9).....	53	49	43	4	2
Cleft palate (12.0-12.9).....	35	27	24	2	1
<i>Anencephaly</i> (20.1).....	8	8	8	0	0
<i>Encephalocele</i> (21.1, 21.2).....	6	3	1	2	0
<i>Spina bifida</i> (22.0-22.5).....	34	32	31	0	1
<i>Hydrocephalus</i> (23.0).....	19	13	9	0	4
<i>Anophthalmos and microphthalmos</i> (26.0-26.5).....	17	8	2	3	3
<i>Omphalocele</i> (40.0, 40.1).....	14	10	9	0	1
<i>Esophageal defect</i> (45.0-45.5).....	12	5	4	0	1
<i>Imperforate anus</i> (48.0-48.9).....	12	9	7	1	1
<i>Major positional foot defect</i> (60.0, 60.2).....	95	45	28	15	2
<i>Polydactyly</i> (61.0-61.9).....	95	46	24	17	5
<i>Reduction deformities</i> (64.0-64.7).....	58	35	18	5	12
<i>Mongolism</i> (75.0-75.2).....	66	27	16	11	0
Total, all selected malformations.....	557	342	247	62	33

<sup>1</sup> Reference 11 and "The Iowa Study Classification of Congenital Malformations."

erable accuracy. Among the selected malformations of the central nervous system, anencephaly and spina bifida showed a high proportion of accurate reporting. The reported diagnoses of omphalocele, esophageal defects, and imperforate anus were also high in accuracy.

The least accurately reported were anophthalmos and microphthalmos, encephalocele, and reduction deformities.

Table 4 also shows that the reporting of reduction deformities on birth certificates was unique in that no other category of malformation contained so many poorly defined entries. On most of these certificates the entry was unspecified deformity of a limb.

Although few defects are reported on birth certificates, the malformations studied showed that anomalies are more often than not reported accurately. This relative accuracy, however, is small help to an investigator who misses many of his study cases because of incomplete reporting.

### Comments

This study has supported the findings of others that malformations observed in newborn babies are incompletely reported on their birth certificates. Variables descriptive of the child, his parents, and his birth are apparently not related to the same extent as severity of the defects and ease in recognizing them are to the reporting of malformations on birth certificates. This observation leads to confidence in the use of birth certificates as source material for epidemiologic studies of specific malformations in which the characteristics in a particular population of affected persons are compared with the same characteristics in a control population. The considerable underreporting of malformations on birth certificates, however, severely restricts their use for estimating the incidence of malformations, especially those of minor severity or those not easily recognized.

Other factors may influence the reporting of malformations. Within the hospital setting, some medical staffs seem to place recordkeeping and the attendant paperwork at a low priority. In the files reviewed for this study, there were many examples of fragmentary notes, imprecise and ambiguous entries, and disregard for dating or signing the observations. A physician having a large number of patients would not be able to use incomplete hospital notes easily when he prepares the health and medical portion of the birth certificate. Studies based on data from birth certificates

could be vastly improved if physicians took greater care in recording malformations completely and accurately. Hospital administrators could assist the physicians by establishing appropriate procedures. Thus, we have a loose procedural path from pediatric examination to hospital records and finally to the transfer of information to a birth certificate.

There is no reason to believe the experience in Iowa is atypical of vital statistics reporting in other areas of the United States. Local registrars may need to survey the utilization of the congenital malformation item on birth certificates and to maintain a watchful surveillance of it.

### Limitations

1. Because several people were abstracting the hospital records, some variability may have been introduced in the selection of material. This possibility will be examined in a subsequent report.

2. All available clinical material may not have been accessible to the abstractor if the attending physician retained any records in his office or if the hospital records were not in good order.

3. All available clinical material may not have been accessible to the physician when the birth certificate was signed.

4. Nonconfirmed diagnoses in the hospital records were included.

5. Space limitations on the birth certificate may have resulted in the single entry "multiple malformations" or "and others," whereas all individual malformations may have been enumerated in the hospital record.

6. Some malformations occurred too rarely for reliable comparison.

7. Some physicians may have consciously withheld information on a malformation from the birth certificate to avoid "stigmatizing" the child.

8. Decisions concerning agreement in reporting to some extent were necessarily subjective.

9. The number of malformations diagnosed before the birth certificates were signed is not known with certainty. The study is based upon all malformations recorded on medical records during initial hospitalizations of the infants.

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**MACKEPRANG, MURIEL (Public Health Service), HAY, SYLVIA, and LUNDE, ANDERS S.: *Completeness and accuracy of reporting of malformations on birth certificates. HSMHA Health Reports, Vol. 87, January 1972, pp. 43-49.***

The completeness and the accuracy of reporting of congenital malformations on birth certificates were examined by comparing birth certificates of all infants registered in Iowa in 1963 with hospital records of their birth. Records of newborn infants from 144 hospitals provided information for 57,909 births. Records of 5,471 infants were abstracted. About 39 percent of major malformations, 9 percent of minor malformations, and 1 percent of insignificant anomalies were reported on birth certificates. Severity and ease of recognition of the malformations were signifi-

cant factors in the completeness of reporting malformations on birth certificates. No statistically significant difference was found between major and minor malformations reported on birth certificates and those not reported for the following variables: birth weight, length of gestation, sex, survival at discharge, plurality, age of mother, age of father, race of mother, race of father, number of previous deliveries of mother, and month or day of week of birth. Performance of an autopsy showed a statistically significant negative association with report-

ing of malformations on birth certificates. Whether a mother was a private patient or not appeared to be spuriously related to completeness of reporting as a result of the recording practices of one hospital.

Records of selected malformations were examined for accuracy of reporting. Overall, about 72 percent of the malformations reported on birth certificates agreed with the diagnoses in the corresponding hospital records, but accuracy for individual malformation groups ranged from 25 to 100 percent.