Accuracy of the Reported Causes of Fetal and Neonatal Deaths

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CAUSE-OF-DEATH statistics obtained from fetal and neonatal death certificates provide a means by which health departments can contribute to investigations of perinatal wastage. It is important, therefore, to be aware of the limitations of such statistics.

This paper reports a study of the accuracy of the causes of perinatal deaths given on death certificates submitted to the Baltimore City Health Department by the Johns Hopkins Hospital during 1953 (calendar year). One hundred and twenty-seven deaths are included; 50 were fetal deaths, and 77 were early neonatal deaths (70 during the first week of life and 7 during the second week).

An investigation of the accuracy of the reported causes of perinatal deaths implies that there is available a statement of the real cause of death with which the reported cause can be compared. No claim is made that the true cause of death was known for each of the deaths in this study, but it was possible to obtain a reasonably good substitute.

During 1953 the perinatal autopsy rate at the Johns Hopkins Hospital approached 100 percent. The pathological data obtained at autopsy and the clinical history for each death in this study were reviewed by obstetricians and pediatricians at an infant mortality conference. The results of the conference discussion, together with the pathology report and the clinical history, were used as a basis for determining the cause of the fetal or neonatal loss. This cause was posted to a death certificate, designated the "special certificate," of the type used by the Baltimore City Health Department in 1953. For this study, it was assumed that the information recorded on the special certificate represented the best available approximation of the true cause of death.

The original certificate for each death was in the files of the Baltimore City Health Department and was not seen by the physician who completed the special certificate. The physician who completed the original certificate had access only to the clinical history and possibly gross pathological findings. Exactly what information was used in preparing each of the original certificates is not known.

All causes of death were coded in accordance with the International Statistical Classification of Diseases, Injuries, and Causes of Death (sixth revision). The special certificates were coded by the same nosologist who had coded the original certificates in 1953.

Accuracy of the original certificates was measured by the percentage of the deaths studied in which the reported cause agreed with the cause given on the special certificate. Agreement was determined from a comparison of the international statistical classification code numbers assigned to the causes given on the special and the original certificates.

For fetal deaths two degrees of agreement were established. The first, which represents a high degree of matching, required agreement in the first two digits of the code. For example, a certificate ascribing a fetal death to difficult

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labor with abnormality of the bones of the pelvis, coded Y34.0, was considered in agreement with its companion certificate if it attributed death to difficult labor without mention of the underlying condition, coded Y34.6. The second, and more liberal appraisal of agreement, was based on three broad groups of causes of fetal death, namely, causes and conditions in the mother; causes determined in fetus, placenta, and cord; and unknown or ill-defined causes.

Agreement for the causes of neonatal death was determined from a comparison of the special and original certificates according to the rubrics used in the annual report of the Baltimore City Health Department for 1953. These rubrics were as follows: congenital malformation, birth injury, postnatal asphyxia and atelectasis, infection of the newborn, hemolytic and hemorrhagic disease of the newborn, immaturity, and all other causes. The analysis of the accuracy of the causes of neonatal death was complicated by the fact that the classification hyalinelike membrane appeared on the special certificates but was not used at the time the original certificates were prepared.

Fetal Deaths

Agreement between the special and original certificates was 60 percent for fetal deaths; that is, the causes agreed for 30 of the 50 cases studied (table 1). Sixteen of the special certificates ascribed fetal death to causes and conditions in the mother. Of these, only six were matched by the causes given on the original certificates. Thus, the percentage agreement for this group of causes was about 38. Five of the unmatched cases were in the category "toxemias"; two were in "difficulties in labor"; one was in "chronic disease"; and the remaining two deaths were attributed to other causes and conditions in the mother.

There were 18 fetal deaths ascribed on the special certificates to causes determined in fetus, placenta, and cord. Thirteen, or 72 percent, of the original certificates for these deaths gave the same cause. Premature separation of the placenta was the cause for 3 of the 5 nonmatching cases.

For the 16 deaths from unknown or ill-defined causes, 11, or 69 percent, were assigned to this category on the basis of the original certificates. Three of the five nonmatching deaths were ascribed to causes and conditions in the mother on the original certificates.

These results indicate that fetal deaths due to causes and conditions in the mother are inaccurately reported more frequently than deaths due to conditions determined in the fetus. However, the size and scope of this study are such that this generalization must be considered guardedly. The 50 fetal deaths

Table 1. Comparison of the causes of fetal death given on special and original death certificates, Baltimore City, Md., 1953

Cause of death according to special certificate [1]	Total	Cause of death according to original certificate									
		A1	A2	A3	A4	B1	B2	B3	B4	B5	C
Total	50	2	4	1	3		11	4	1	1	23
A. Causes and conditions in mother:											
1. Chronic disease (30.0–30.5)	3	2									1
2. Toxemias (32.3, 32.4)	7		2				1				4
3. Difficulties in labor (34.0–34.6)	2										2
4. Other (31.0–31.4, 32.0, 32.2, 32.5, 35.0–35.2)	4				2						2
B. Causes determined in fetus, placenta, and cord:											
1. Placenta previa (36.1, 36.3)	1						1				
2. Premature separation (36.2, 36.4)	11		1				8				2
3. Other placenta and cord (36.0, 36.5, 36.6)	4							4			
4. Congenital malformation (38.0–38.7)	1								1		
5. Erythroblastosis (39.2)	1										1
C. Unknown or ill-defined (35.3, 39.4–39.6)	16		1	1	1		1			1	11

[1] Numbers in parentheses are international statistical classification code numbers, with Y prefix omitted.

Table 2. Number and percentage of fetal deaths by cause for study deaths and all deaths [1] in Baltimore City, Md., 1953

Cause of death [2]	Number			Percent		
	Study		Baltimore City	Study		Baltimore City
	Special certificate	Original certificate		Special certificate	Original certificate	
All causes	50	50	391	100. 0	100. 0	100. 0
Causes and conditions in mother	16	10	65	32	20	16. 6
Chronic disease (30.0–30.5)	3	2	11	6	4	2. 8
Toxemias (32.3, 32.4)	7	4	28	14	8	7. 2
Difficulties in labor (34.0–34.6)	2	1	11	4	2	2. 8
Other (31.0–31.4, 32.0, 32.2, 32.5, 35.0–35.2)	4	3	15	8	6	3. 8
Causes determined in fetus, placenta, and cord	18	17	145	36	34	37. 1
Placenta previa (36.1, 36.3)	1	0	0	2	0	0
Premature separation (36.2, 36.4)	11	11	76	22	22	19. 4
Other placenta and cord (36.0, 36.5, 36.6)	4	4	35	8	8	9. 0
Congenital malformation (38.0–38.7)	1	1	17	2	2	4. 3
Erythroblastosis (39.2)	1	1	16	2	2	4. 1
Birth injury (37.0–37.8)	0	0	1	0	0	0. 3
Unknown or ill-defined (35.3, 39.4–39.6)	16	23	181	32	46	46. 3

[1] Deaths after 20 weeks or more gestation.
[2] Numbers in parentheses are international statistical classification code numbers, with Y prefix omitted.

were purposively selected from a total of 391 deaths (20 weeks or more gestation) that occurred in Baltimore City during 1953. Moreover, they are all from one teaching hospital. It is of interest, therefore, to compare the distribution of the causes for the study deaths with the distribution of the causes for all fetal deaths in the city during the same period. The comparative data are shown in table 2.

Twenty percent of the study deaths were ascribed to causes in the mother on the original certificates, compared with 16.6 percent of all fetal deaths. For causes in the fetus, placenta, and cord, the percentages were 34 for the study group and 37.1 for all deaths; for unknown or ill-defined causes, they were 46 and 46.3. Thus, for these broad groups the largest percentage difference between the study deaths and all deaths is less than 4. It seems fair to say, therefore, that, with respect to causes of death, the sample is representative of the total fetal death experience in Baltimore during 1953.

A comparison of the percentage distributions of the causes given on the special, the original, and all certificates shows the following:

1. Fetal deaths were ascribed to causes and conditions in the mother about twice as often on the special certificates as on either the original certificates or on the certificates for all fetal deaths.

2. The frequency of causes determined in fetus, placenta, and cord was about the same for the three sets of certificates.

3. Fetal deaths ascribed to unknown or ill-defined causes were more frequent on the original certificates and on the certificates for all deaths than they were on the special certificates.

These findings suggest that in tabulations of fetal deaths by cause there is a tendency to underestimate the importance of maternal conditions as a primary factor in fetal loss.

Neonatal Deaths

For neonatal deaths, agreement between the special and original certificates was observed in

only 27, or 35 percent, of the 77 cases studied (table 3). One of the major reasons for this relatively low percentage agreement, however, is that the rubric hyalinelike membrane (code 527) was not used in 1953 when the original certificates were coded. If the 18 special certificates that give this cause are omitted, the percentage agreement becomes 46 (27 of 59 deaths).

It is interesting that of the 18 deaths ascribed to hyalinelike membrane on the special certificates, 9 were originally attributed to postnatal asphyxia and atelectasis, a cause which at the time was reasonable for deaths that might now be listed as due to hyalinelike membrane. Of the other 9 deaths due to hyalinelike membrane, 4 were originally ascribed to birth injury, 4 to immaturity, and 1 to "all other causes."

Of the causes of neonatal death, there were only two in which the percentage agreement between the special and original certificates was relatively high. These were congenital malformations and hemolytic and hemorrhagic disease of the newborn. In the rubric birth injury, only 5 of the 14 special certificates were matched by the original certificates; 5 were originally ascribed to postnatal asphyxia and atelectasis and 4 to immaturity. Of the 7 deaths assigned to asphyxia and atelectasis on the special certificates, 4 were matched and 3 were originally listed as due to immaturity. Not quite one-half of the deaths attributed to infection of the newborn on the special certificates were similarly designated on the original records; 6 of the 16 deaths from this cause were reported as due to immaturity. Immaturity did not appear as a cause of death on the special certificates.

Although the supporting data are not shown in table 3, it was observed that the percentage agreement between the special and original certificates was markedly different for mature and premature infants. In the group of 58 infants whose birthweight was less than 2,500 gm., matching causes were found on only 11 sets of certificates, or 19 percent. For infants whose birthweight was 2,500 gm. or more, on the other hand, there was agreement for 14 of the 19 cases, or 74 percent. Part of this difference is associated with the fact that hyalinelike membrane was given as the cause of death for more than one-half of the premature infants.

A comparison of the causes for the neonatal deaths in the study with the causes for all neonatal deaths reported among Baltimore City residents in 1953 is shown in table 4. Postnatal asphyxia and infection of the newborn were found more frequently as causes of neonatal death among the original certificates for the study group than among all the certificates for 1953. Deaths due to immaturity were found less frequently among the original study certificates.

Table 3. Comparison of the causes of neonatal death given on special and original death certificates, Baltimore City, Md., 1953

Cause of death according to special certificate [1]	Total	Cause of death according to original certificate							
		A [2]	B	C	D	E	F	G	H
Total	77		9	10	23	8	2	21	4
Total excluding deaths due to hyalinelike membrane	59		9	6	14	8	2	17	3
A. Hyalinelike membrane (527)	18			4	9			4	1
B. Congenital malformations (750–759)	10		8		1		1		
C. Birth injury (760–761)	14			5	5			4	
D. Postnatal asphyxia and atelectasis (762)	7				4			3	
E. Infection of newborn (763–768)	16			1	1	7		6	1
F. Hemolytic and hemorrhagic disease of newborn (770–771)	1						1		
G. Immaturity (774, 776)									
H. All other causes	11		1		3	1		4	2

[1] Numbers in parentheses are international statistical classification code numbers.
[2] Hyalinelike membrane was not used when original certificates were filled out.

Table 4. Number and percentage of neonatal deaths, by cause for study deaths and all deaths,[1] Baltimore City, Md., 1953

Cause of death [2]	Number			Percent		
	Study		Baltimore City	Study		Baltimore City
	Special certificate	Original certificate		Special certificate	Original certificate	
All causes	77	77	449	100.0	100.0	100.0
Hyalinelike membrane (527)	18	0	0	23.4	0	0
Congenital malformations (750–759)	10	8	41	13.0	10.4	9.1
Birth injury (760–761)	14	11	69	18.2	14.3	15.4
Postnatal asphyxia and atelectasis (762)	7	23	96	9.1	29.8	21.4
Infection of newborn (763–768)	16	8	20	20.8	10.4	4.5
Hemolytic and hemorrhagic disease of newborn (770–771)	1	2	9	1.3	2.6	2.0
Immaturity (774, 776)	0	20	191	0	26.0	42.5
All other causes	11	5	23	14.2	6.5	5.1

[1] Resident deaths during the first week of life.
[2] Numbers in parentheses are international statistical classification code numbers.

Although use of the rubric hyalinelike membrane on the special certificates makes it difficult to compare these with the other two sets, two features of the data are discernible. First, infection of the newborn was found more frequently on the special certificates than on the original certificates for the study group or on all the 1953 certificates: The percentages are 20.8, 10.4, and 4.5, respectively. Second, immaturity, which was not given as a cause of neonatal death on the special certificates, appeared on a relatively large percentage of the original certificates and on an even larger percentage of all certificates.

Discussion

In this study the causes of death reported on about 40 percent of the original fetal death certificates failed to match the causes given on special certificates. For neonatal deaths not attributed to hyalinelike membrane, about 56 percent of the original certificates gave a cause of death that did not agree with the cause posted to special certificates. These estimates relate to the experience of only one hospital, but there is evidence that the deaths studied represent the total experience of the city reasonably well. Thus, the implication is that inaccuracies of the same magnitude exist in the tabulations of citywide perinatal deaths by cause.

One might speculate about how much death certificate data are affected by inaccurate or incomplete reports of clinical findings, by different interpretations of accurately reported findings, by the zeal of those filling out the certificates, or by differences that arise when coders transform a written diagnosis into the symbols used to prepare punchcards for statistical analysis. But a study as limited as this one cannot identify or appraise such factors precisely.

The indication that inaccuracies exist is not in itself particularly valuable information. What is of more interest to both producers and consumers of death certificate data is the nature of the inaccuracies and the practical measures that can be taken to prevent them.

With regard to the first point, this study indicates that fetal deaths due to causes and conditions in the mother actually occur about twice as often as is shown on death certificates. For neonatal deaths, the data suggest that, apart from deaths due to hyalinelike membrane, infection of the newborn is the most frequently under-reported cause of death.

With regard to the measures that can be taken to improve the quality of death certificate information, it is necessary to keep in mind the

nature of the inaccuracies and to note the characteristics of the special and original certificates that might have a bearing on the inaccuracies. Recall that the physician preparing the special certificate had at hand the clinical history, a detailed report of pathology, and the results of an infant mortality conference. Moreover, he was aware that a test of accuracy was in progress. Contrast this situation with that which probably existed at the time the original certificate was completed. The clinical history was available on request, but only gross findings of the autopsy, if any at all, could be obtained. In addition, the physician completing the original certificate was not under test conditions, although he did know that his report would be made part of a clinical history which would be reviewed at an infant mortality conference.

These considerations indicate that inaccuracies in the original certificates could have arisen as follows: For fetal deaths, although pathological data could have been used to eliminate several possible causes, it seems likely that inaccuracies involving causes in the mother can be attributed to inadequate study of the available information. For neonatal deaths, where under-reporting of infection of the newborn was the most striking finding, a stronger case can be made for the necessity of having pathological data. This is certainly true if hyalinelike membrane is to be used in a meaningful way as a cause of neonatal death.

Thus, this study suggests that the quality of death-certificate data for perinatal deaths could be improved by a more intensive study of available clinical records and by the use of pathological data, especially in assigning causes of death during the neonatal period of life. The first of these recommendations might be implemented by holding periodic conferences with resident obstetrical staff, preferably timed to coincide with the beginning of the term of a new residency, and by making frequent checks of the completeness of fetal and neonatal death certificates. The second could be supported by querying the certifying physician or the hospital in all cases in which there is an indication that an autopsy has been performed.

Summary

A study of 50 fetal and 77 neonatal death certificates submitted to the Baltimore City Health Department by the Johns Hopkins Hospital during 1953 found that some 40 to 50 percent of the cause-of-death statements did not agree with those posted to special certificates based on careful examination of the clinical history, a detailed pathological report, and the findings of an infant mortality conference. The study indicates that deaths due to maternal conditions and causes are under-reported among fetal deaths and that deaths due to infection of the newborn are under-reported among neonatal deaths.

Consideration of the nature of the inaccuracies in conjunction with the conditions under which the original and special certificates were prepared suggests that the quality of death certificate information about perinatal deaths might be improved by a more intensive study of the clinical data and by use of autopsy findings.