

Invalid certification of young deaths

R SUNDERLAND AND E P SUNDERLAND

Sheffield Children's Hospital

SUMMARY Necropsy reports were traced for 3928 of the 7049 Sheffield children who died between 1947 and 1979. Comparison of these reports with the related death certificates showed important differences in the underlying cause of death in 15%, even after allowing for variation in diagnostic terms and incorrect completion of certificates. Approximately one third of certificates had the underlying cause of death entered first instead of last in Part I, and in 251 (6%), the underlying cause of death was found in Part II of the certificate. There was an overrepresentation of infectious diseases and underrepresentation of malformations, deaths associated with perinatal factors, and cot deaths in the death certificates. Discrepancies were more frequent among very young children and among hospital deaths than home deaths. There was little variation in discrepancy frequency when analysed by parental occupation. A gradual decrease in the proportion of discrepancies occurred during the period studied, but this may be a consequence of a changing pattern of referral for necropsy rather than increasingly valid certification. The historical diagnoses 'convulsions due to an unknown but natural cause' and 'teething convulsions' may be analogous to the current diagnosis 'sudden infant death syndrome'.

Accurate death certification is a prerequisite for the derivation of reliable mortality statistics. Accurate certification of child deaths is particularly important as these records are widely used as an index of national health.¹ A number of studies have shown wide discrepancy between the certified cause of death and necropsy findings.^{2–5} Many of these studies excluded or underrepresented child deaths. We examine the validity of the child death certificate archive by comparing necropsy findings with certified causes of death of all children dying in a stable urban community during a 33 year period.

Materials and methods

With the permission of the Registrar General and under the supervision of the Sheffield Registrar of Births, Deaths, and Marriages, every death certificate issued in Sheffield between 1 January 1947 and 31 December 1979 was examined and details abstracted of any child with a stated age of 15 years or less. Copies of death certificates of any Sheffield children who died outside the city were obtained from the Sheffield Area Health Authority (Information Services).

The home address given on each certificate was checked against the official *Index of Sheffield Streets* which had been in use at the time of death (because

of boundary changes this index was revised in March 1953, March 1968, and March 1974). All children whose home address was in the relevant index were defined as Sheffield children and included in the study.

With permission, the records of the Sheffield Coroner and of all laboratories in the city that perform necropsies on children were searched for reports relating to these Sheffield children. Necropsy reports for outside deaths were obtained from the relevant coroner or hospital. Identification was by name and date of death.

The international rules for arriving at the underlying cause of death were followed whenever possible.⁶ The general rule is that the underlying, indexed cause of death is the entry on the lowest line of Part I of the death certificate—that is, the underlying cause I(c) takes precedence over the antecedent cause I(b) which takes precedence over the immediate cause of death I(a). Part II of the certificate deals with conditions contributing to death but not related to the disease causing death. In this study, nonsensical registrations were corrected and not classed as inaccuracies eg 'Placental insufficiency due to prematurity due to respiratory distress syndrome' was not considered to disagree with the necropsy summary 'Extensive hyaline membrane disease in a child born after 30 weeks'

gestation; multiple placental infarcts'. Thus, if the underlying cause of death on the necropsy report was found anywhere in Part I of the death certificate then the certification was considered valid. Where major discrepancies were found between necropsy report and death certificate, the certificate was classed as invalid: 'Respiratory failure due to renal tuberculosis' was considered to disagree with the necropsy report 'Disseminated neuroblastoma, no acid-fast bacilli seen in any section'. Causes of death were grouped into 7 categories (see Table 1). Discrepancies were arbitrarily classed as major if the revised cause of death was in a different category from the certified cause and minor if in the same category. Thus the discrepancy between 'respiratory failure due to meningitis' (certificate) and 'untreated spina bifida, secondary meningeal infection' (necropsy) was classed as major while 'dehydration due to gastroenteritis' (certificate) and 'widespread bronchopneumonia' (necropsy) was classed as minor, as this discrepancy did not alter the overall record of fatal infectious diseases. Where the underlying cause of death on the necropsy report was found in Part II of the death certificate then 'incorrect word order' was ascribed: '(a) Cardio-pulmonary failure (b) pneumonia II cerebral palsy' contrasted with the necropsy summary 'Spastic

quadriplegia, hypostatic pneumonia (pneumococcal), severe perinatal hypoxia'.

The necropsy report was not always assumed to be correct. The certification 'Idiopathic respiratory distress syndrome due to prematurity' was considered valid despite a necropsy report 'Congenital heart disease—patent ductus arteriosus' because the child weighed 1800 gm and died at 12 hours of age when the ductus might still be patent.

Results

There were 7049 Sheffield child deaths between 1947 and 1979. Details of parental social class were not available for 46 children and the place of death of 187 was unclear. Necropsy reports were traced for 3928 children. Analysis of discrepancies between these necropsies and the corresponding death certificates is given by cause of death, age, social class, and place of death in Tables 1–4.

In Table 1 the deaths are grouped in the corrected categories. 'Epinatal' has been used as a generic term for deaths that were a consequence of events relating to birth (maternal or placental diseases, birth trauma, immaturity etc). Most discrepancies in the epinatal group were cases where birth trauma or underlying maternal disease had been omitted

Table 1 *Validity of certified cause of death by pathology*

Cause	Agreement	Disagreement			Total
	No (%)	Major No (%)	Minor No (%)	Incorrect word order No (%)	
Epinatal	955 (79.1)	59 (4.9)	158 (13.1)	35 (2.9)	1207
Malformation	640 (71.1)	91 (10.1)	40 (4.5)	129 (14.3)	900
Infection	373 (77.1)	49 (10.1)	51 (10.5)	11 (2.3)	484
Unnatural	447 (97.2)	9 (1.9)	3 (0.7)	1 (0.2)	460
Tumour	87 (82.1)	7 (6.6)	9 (8.5)	3 (2.8)	106
Unexplained	448 (82.4)	51 (9.4)	40 (7.3)	5 (0.9)	544
Miscellaneous	135 (59.5)	15 (6.6)	10 (4.4)	67 (29.5)	227
Total	3085 (78.5)	281 (7.2)	311 (7.9)	251 (6.4)	3928

Table 2 *Validity of certified cause of death by age*

Age	Agreement	Disagreement			Total
	No (%)	Major No (%)	Minor No (%)	Incorrect word order No (%)	
< 1 week	1191 (78.8)	99 (6.6)	160 (10.6)	61 (4.0)	1511
1–3 weeks	226 (76.1)	26 (8.8)	30 (10.1)	15 (5.0)	297
1–11 months	836 (74.6)	115 (10.2)	87 (7.8)	83 (7.4)	1121
1–4 years	429 (81.6)	31 (5.9)	27 (5.1)	39 (7.4)	526
5–9 years	239 (84.8)	4 (1.4)	5 (1.8)	34 (12.0)	282
10–14 years	136 (85.5)	5 (3.1)	2 (1.3)	16 (10.1)	159
15 years	28 (87.6)	1 (3.1)	0 (0.0)	3 (9.4)	32
Total	3085 (78.5)	281 (7.2)	311 (7.9)	251 (6.4)	3928

Table 3 *Validity of certified cause of death by social class*

Social class	Agreement		Disagreement			Total
	No	(%)	Major No (%)	Minor No (%)	Incorrect word order No (%)	
I	97	(79.5)	12 (9.8)	7 (5.8)	6 (4.9)	122
II	236	(77.6)	25 (8.2)	26 (8.6)	17 (5.6)	304
III NM	187	(75.7)	17 (6.9)	28 (11.3)	15 (6.1)	247
III M	1457	(77.8)	124 (6.6)	160 (8.6)	131 (7.0)	1872
IV	418	(79.0)	42 (7.9)	41 (7.8)	28 (5.3)	529
V	477	(80.2)	49 (8.2)	28 (4.7)	41 (6.9)	595
Illegitimate, employed	70	(76.1)	6 (6.5)	13 (14.1)	3 (3.3)	92
Illegitimate, unemployed	97	(87.4)	4 (3.6)	7 (6.3)	3 (2.7)	111
Unemployed	9	(90.0)	0 (0.0)	1 (10.0)	0 (0.0)	10
Unknown	37	(80.4)	2 (4.4)	0 (0.0)	7 (15.2)	46
Total	3085	(78.5)	281 (7.2)	311 (7.9)	251 (6.4)	3928

Table 4 *Validity of certified cause of death by place of death*

Place of death	Agreement		Disagreement			Total
	No	(%)	Major No (%)	Minor No (%)	Incorrect word order No (%)	
Hospital	2106	(75.0)	239 (8.5)	262 (9.4)	200 (7.1)	2807
Home	794	(85.0)	42 (4.5)	48 (5.1)	50 (5.4)	934
Unknown	185	(99.0)	0 (0.0)	1 (0.5)	1 (0.5)	187
Total	3085	(78.5)	281 (7.2)	311 (7.9)	251 (6.4)	3928

from the death certificate. Disagreements in the malformation category mostly arose where death had been attributed to an infection, with the malformation (such as untreated spina bifida) entered in Part II or not recorded. Similarly, many handicapped children (grouped under miscellaneous) were registered as dying from infections with the handicap omitted or entered in Part II. Discrepancies in the unexplained category were mostly deaths registered as infections but where subsequent careful histological examination found no evidence of infection (eg cot deaths). There were four infants registered as

dying from 'convulsions' or 'teething convulsions', two of whom had a necropsy. Apart from mild inflammatory changes in the upper airways there was no important pathology, and the pathologist was unable to explain these deaths. They would probably be registered as cot deaths today. The disagreements under unnatural causes of death include cases where, because of further study, often months after the coroner issued a death certificate, the pathologist changed his mind as to the cause of death (eg from gastroenteritis to acro-dynia).

Analysis of discrepancies by age showed little variation after the first year (Table 2). There was little variation of disagreement by social class (Table 3) and further analysis by socioeconomic group and by specific occupation also showed little variation—ranging from 7.6% (unskilled manual workers) to 10.0% (non-manual service trades): there were 8.9% invalid certificates among doctors' children. Variation of the observed discrepancies with time (Figure) shows an increasing level of validity in the most recent years.

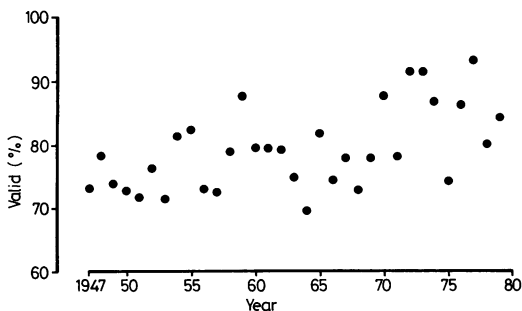


Figure *Percentage of valid certificates by year.*

Discussion

In 1676 John Graunt drew attention to the errors

and ambiguities in the 'Bills of Mortality' because of the method used to determine the cause of death—'The searchers hereupon (who are ancient matrons sworn to their office) repair to the place where the dead corps lies, and by view of the same, and by their enquiries, they determine by what cause or casualty the corps died'.⁷ Generous helpings of liquor sometimes played a part in these lay inquests and inflated returns from epidemic diseases such as cholera may have led to public panics.⁸

There is often considerable uncertainty by the certifying doctor as to the accuracy of the stated cause of death.⁹ In about half of all adult deaths the certified cause of death is incorrect (25% being gross errors) with the frequency of discrepancy rising with increasing age.^{2-5 10} Studies of child deaths have showed fewer inaccuracies.¹¹⁻¹⁴ The commonest source of serious discrepancy in the present study was the registration of deaths from infection, where a malformation or handicap had been omitted or placed in Part II (Table 1). Discrepancies among first week deaths may be particularly important as there was a lower necropsy rate in this age group (Table 2). Kane¹⁵ found that the rate of congenital malformations among 3700 perinatal deaths was doubled after a careful necropsy.

The histological record on the children who died from 'convulsions' may be of historical importance because of the prevalence of this diagnosis in earlier years. Between 1890 and 1900 there were 300-400 such deaths per year in Sheffield, classified separately from deaths due to epilepsy, meningitis, or overlying. It is not advisable to extrapolate back half a century on the strength of these records but the possibility emerges that unexpected, inexplicable infant deaths were commoner than has previously been appreciated.

The distribution of inaccuracy of death registration by social class does not seem to have been examined previously. The uniformity of distribution in the present study (Table 3) contradicts the speculation that inaccurate certificates would be more likely among the children of lower social class parents and that the children of doctors are likely to have the most detailed diagnoses.¹⁶ The higher proportion of inaccurate certificates among hospital deaths (Table 4) argues against any suggestion that hospital deaths might be more carefully documented. These deaths might, however, include more complex pathologies and might be certified by less experienced doctors. The proportion of inaccurate certificates among hospital deaths is consistent with other studies which found that accuracy of registration did not improve with increasing length of stay in hospital.^{10 11}

Apart from the overrepresentation of fatal

infections, discrepancies in this study balanced out so that the death certificate archive may give a reasonable approximation of the overall pattern of fatal childhood diseases. This overall picture is of limited value, however, to any more detailed analysis into child mortality. The upward trend in the proportion of valid certificates in recent years (Figure) is encouraging, but this could be affected by the changing pattern of child necropsies—an increasing proportion are now done at the coroner's request where full agreement between certifier and pathologist would be expected.

As a clinician can attend the necropsy before completing the death certificate, and as the pathologist studies any clinical records before doing a necropsy, there should be no discrepancies—'consistency in certification is biased in favour of a persisting diagnosis'.¹⁷ Some of the discrepancies in this study arise from the yield of new information from histological studies, but some may arise from lack of care when completing the certificate.¹⁸

Perhaps it is unreasonable to expect full agreement between clinician and pathologist. Although one can display all the tissues, the other has observed the fatal process unfold. Koran^{19 20} reviewed a series of studies into the interpretation of signs, symptoms, investigations, and treatment and found that when a group of doctors was given the same information in a different order or after a short period, they disagreed with themselves and their colleagues in 10-20% of the cases. The present study has found an overall disagreement of 15% between information summarised by clinicians and by pathologists. There may be a confidence limit of 85% on such diagnoses.

Some studies of the validity of certification compared only the last entered cause of death on the death certificate and necropsy record. Heasman and Lipworth showed that this would give rise to many artefactual discrepancies, eg children dying with neural tube defects were often certified 'spina bifida due to hydrocephalus' by pathologists but 'hydrocephalus due to spina bifida' by clinicians.² The disagreements found in the present study are of a lower order than most other studies, which may be because the original records were examined and such discrepancies ignored. These inaccuracies were only identified, however, because a necropsy had been requested.

The falling necropsy rate and continuing inaccuracies in death certification are a cause for concern.²¹ In addition to inaccuracies in completing certificates, discrepancies arise in coding these certificates and the coding rules may compound errors.^{8 11 12 22} This, together with changes in the classifications of diseases (eg leukaemia was classified

among the anaemias until the 1948 revision of the WHO *Classification of diseases*) reduces confidence in statistics produced from central archived records. Kane¹⁵ stated that 'rates of incidence based on unautopsied material . . . are not worth collecting, let alone publishing'. It would seem advisable that, whenever possible, statistics of child mortality be based on the original records with a high level of necropsy verification.

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Correspondence to Dr R Sunderland, Birmingham Children's Hospital, Ladywood Middleway, Birmingham B16 8ET.

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