

Confidential Inquiry into 226 Consecutive Infant Deaths

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Richards, I. D. G., and McIntosh, H. T. (1972). *Archives of Disease in Childhood*, 47, 697. **Confidential inquiry into 226 consecutive infant deaths.** Among 226 consecutive infant deaths (occurring after the first week), the leading causes were: congenital malformation (62 deaths), sudden infant death syndrome (47), pneumonia (36), gastroenteritis (26), and aspiration of gastric contents (16). In only one-third of the deaths was there a known predisposing organic disease. The study confirms the well-known relation between infant mortality and low birth-weight, illegitimacy, poor social conditions, and low standards of parental care. Of particular interest was the finding of a long interval in many of the 'cot deaths' between the child last being seen alive and the discovery of the death.

Half the deaths occurred at home, the leading causes of mortality in 103 'cot deaths' being: sudden infant death syndrome (47), pneumonia (25), and aspiration of gastric contents (14). In at least one-third of the deaths from sudden infant death syndrome, there had been an illness in the previous week, usually an upper respiratory tract infection; peak mortality was in the first quarter of the year (January-March) and occurred in the second and third months of life. Many of the infants dying in hospital were very critically ill on admission.

There was a high prevalence of 'avoidable factors' in the group of deaths with no known predisposing organic disease, and the case histories suggest that deficiencies in both parental and medical care—often in combination—played an important role in many of the deaths investigated.

Many deaths in infancy and childhood are preventable (Selwyn and Bain, 1965; Department of Health and Social Security, 1970; Richards, 1971). Recognition of this fact, together with the high infant mortality rate prevailing in Glasgow (in 1970, 23 per 1000 live births), pointed to the need in this city for a special inquiry into infant mortality. All infant deaths after the age of 1 week, occurring in a 12-month period, were investigated. About a month after the event, one of us (H.T.M.) visited each home to interview one or both of the parents and to assess the family's social conditions. The information recorded was supplemented by reports from general practitioners, health visitors, and pathologists, and also by scrutiny of all relevant hospital records.

During the study period there were 226 deaths, of which 199 (88%) were investigated by interview (Table I). The parents of the remainder had either moved away (10), could not be traced (6), were unwilling to co-operate (6), or were not visited

for a special reason such as language difficulty or because the death was the subject of criminal proceedings. The related number of live births was approximately 17,400.

Cause of Death

The deaths have been classified into two groups—(A) those in which there was *no known predisposing organic disease*, and (B) a group in which such a *predisposing cause was present*. There were 146 deaths (65%) in Group A and 80 (35%) in Group B (Table I). The leading causes were congenital malformation (62 deaths), the 'sudden infant death syndrome' (47), pneumonia (36), and gastroenteritis (28). Deaths ascribed to the 'sudden infant death syndrome' (SIDS) are *deaths unexplained at necropsy*; thorough reviews and extensive bibliographies of this subject are given by Valdés-Dapena (1967) and by Froggatt, Lynas, and Marshall (1968).

All home deaths and most of the hospital deaths were investigated by necropsy; these examinations

TABLE I
226 Infant Deaths Investigated

Group	Cause of Death	No. of Deaths	Investigated by Interview
A	Sudden infant death syndrome (SIDS)	47	41
	Pneumonia	36	33
	Gastroenteritis	28	25
	Other infection*	8	8
	Aspiration of stomach contents	16	13
	Miscellaneous:		
	Suffocation†	7	4
	Injury‡	3	2
	Hypothermia	1	1
	Total	146	127
B	'Prematurity'	7	4
	Birth injury	3	3
	Malformation	62	57
	Miscellaneous:		
	Colitis	1	1
	Perforation of caecum	1	1
	Intussusception	1	1
	Toxic epidermal necrolysis	1	1
	Malabsorption and marasmus	1	1
	Neonatal hepatitis	1	1
	Leukaemia	1	1
	Letterer-Siwe disease	1	1
	Total	80	72
All deaths	226	199	

*Septicaemia 5, meningitis 1, pyelonephritis 1, herpes simplex 1.

†Includes 3 by smoke and 1 by strangulation.

‡2 cases of battering and 1 of accidental injury.

were carried out by experienced pathologists, many being performed in the University Department of Forensic Medicine. Allocation to the categories shown in Table I was based whenever possible on necropsy findings rather than on the

registered cause of death; the underlying cause, rather than the immediate cause of death has been recorded where these are different. A comparison of the ascribed and registered causes is given in Table II. Most SIDS deaths had been registered as 'acute respiratory tract infection'—a common practice intended to allay parental anxiety.

Characteristics of Infants

One hundred and thirty-seven deaths (61%) were in male infants and an excess of males was present for each of the leading causes (SIDS, 60% males; pneumonia, 72%; gastroenteritis, 61%; malformations, 55%).

Thirty-four infants (15%) were illegitimate, the proportion being higher in Group A deaths (19%) than in Group B (8%). The illegitimacy rate for all Glasgow live births in 1970 was 11%.

Fifty infants (22%) weighed 2500 g (5½ lb) or less at birth, the proportions being similar in Group A (23%) and Group B (21%). These rates are greatly in excess of the prevalence of low birthweight (8%) in all Glasgow live births. Of the 47 SIDS deaths, 7 (15%) were in infants of low birthweight, and of the 28 deaths from gastroenteritis, 10 (36%) were in infants of low weight. 7 of the 8 deaths from 'other infection' were associated with a low birthweight.

Family Size and Deaths Among Sibs

Almost a third (31%) of the deaths were in infants with one living sib, the proportions being similar in Groups A and B. However, family size tended to be larger in Group A than in Group B; in the former, 28% had at least 3 living sibs

TABLE II
Comparison of Registered Causes of Death with Cause Ascribed in Investigation

Registered Cause of Death	Group A						Group B				All Deaths
	SIDS	Pneumonia	Gastroenteritis	Other infection	Aspiration	Others	Prematurity	Birth injury	Malformation	Others	
Acute respiratory tract infection	44	3									47
Pneumonia	2	32	2								36
Gastroenteritis			26								26
Prematurity							7				7
Intracranial haemorrhage						3		3			6
Aspiration of vomit	1				16					1	18
Suffocation						4					4
Spina bifida									11		11
Congenital heart disease									40		40
Other malformation									11		11
Other cause		1		8		4				7	20
All causes	47	36	28	8	16	11	7	3	62	8	226

compared with 20% in Group B, the figure for all Glasgow live births being 25%.

At least one previous death of a liveborn sib had occurred in 24 families. A total of 29 sibs had died and their registered causes of death are shown in Table III.

TABLE III
Deaths Among Sibs of the Index Cases

Index Case	Cause of Death of Sibs	Age
SIDS	(1) Convulsion	4½ mth
	(2) Prematurity	1½ hr
Pneumonia	(1) Cot death (bronchopneumonia)	3 mth
	(2) Cot death (bronchopneumonia)	9 wk
	(3) Cot death (gastroenteritis)	2 mth
	(4) Infanticide	1 dy
Gastroenteritis	(5) Prematurity	40 hr
	(6) Prematurity	9 dy
	(1) Gastroenteritis	4 mth
	(2) Bronchopneumonia	4 mth
Suffocation	(3) Congenital heart disease	3 wk
	(4) Congenital heart disease and imperforate anus	2 wk
	(1) (i) Spina bifida	9 mth
	(ii) Pneumonia	2 dy
Prematurity	(2) Cot death (acute respiratory infection)	3 mth
	(3) (i) Congenital heart disease	5 mth
	(ii) Congenital heart disease	5 mth
	(1) Congenital heart disease	9 mth
Malformation	(1) (i) Spina bifida and hydrocephalus	4 mth
	(ii) Spina bifida and hydrocephalus	3 mth
	(2) Down's syndrome and bronchopneumonia	20 mth
	(3) Gastroenteritis	9 dy
	(4) Gastroenteritis	7 mth
	(5) Prematurity	3 wk
Miscellaneous	(6) (i) Cot death (pneumonia)	4½ mth
	(ii) Murdered	5½ yr
	(iii) Pneumonia	4½ mth
	(1) Cot death (SIDS)	4 mth
	(2) Prematurity	1 dy

Parental Social Class

There were only 3 deaths in social classes I and II (prematurity 1, malformation 2), but the proportion of classes IV and V families in the study (62%) was appreciably higher than for all Glasgow live births in 1970 (33%). Of the deaths in Group A, 103 (71%) were in classes IV or V, including 28 SIDS, 29 pneumonia, 21 gastroenteritis, and 11 aspiration deaths, compared with 36 (45%) of Group B deaths. The fathers of 44 infants (20%) were unemployed, the proportion being even higher (24%) in Group A deaths. In the pneumonia group, one-third were unemployed.

Maternal Age

The proportion of young mothers (below 20 years) was higher in the series of deaths (17%)

than among all live births (12%). In Group A deaths there was an excess at maternal ages below 20 and also between 20 and 24 years (16 and 39% respectively) compared with all live births (12 and 35%).

Other Maternal Characteristics and Standards of Infant Care

Assessments of maternal intelligence and efficiency were made at the interview. Of the 127 mothers interviewed in Group A, the intelligence of 68 (54%) was assessed as 'below average' compared with 28 (39%) of the 72 mothers interviewed in Group B. In the three leading Group A causes of death (SIDS, pneumonia, and gastroenteritis), there was an excess of mothers whose intelligence was rated as below average. Similarly, 80 (63%) in Group A were below average in domestic efficiency compared with 26 (36%) in Group B. Only one mother went out to work; the child died of gastroenteritis.

Of the 121 homes visited in Group A, 18 (15%) were considered by the interviewer to be dirty compared with 6 (9%) of the 69 Group B homes.

Of the 133 infants in Group A eligible for attendance at a local authority child health clinic and for which the information was available, only 17 (13%) had attended regularly and 90 (68%) had not attended at all. The proportion of non-attenders in the three principal groups were: SIDS, 66%; pneumonia 71%; and gastroenteritis, 71%.

Of the 54 Group A infants eligible for immunization according to the recommended schedule, 39 (72%) had received none at all.

Family Problems

Among the 199 cases investigated by parental interview, 57 families (29%) had serious problems, there being 44 in Group A (35%) and 13 in Group B (18%). The principal problems were—(a) illegitimacy (31 cases; 14 mothers were cohabiting, usually with a married man) and (b) a very tense intramarital situation (22 cases). Such problems existed in 67% of SIDS deaths, 33% of pneumonia deaths, and 40% of gastroenteritis deaths. Typical backgrounds to the SIDS cases are illustrated by the following examples.

Case 7. SIDS at 3 weeks. When the father had not arrived home by 7.30 p.m. the baby's mother went to her mother-in-law's house taking with her the baby and her other child, a toddler. The father arrived later, drunk, and they all set off for home at 9.45 p.m. When

they arrived outside their house, the mother, fearing there was going to be a row, left the baby with her husband while she and her toddler went back to spend the night at his mother's. On waking in the morning, he found the child to be dead.

Case 157. SIDS at 8 months. The baby was illegitimate and spent the first four months of its life in a children's home. The father (who was unemployed) said they had abandoned their three children one week after his wife had come out of the maternity hospital because, 'the State refused to give us clothing and so they can . . . get on and look after them'. The home was *very* dirty. The baby, who appeared well on the previous day, was found dead in her cot at 10 a.m., having last been seen at 10 p.m. the previous night.

Case 218. SIDS at 4 months. The parents had separated, the 20-year-old mother having left her three children with her husband. Because of financial difficulties, the electricity supply was cut off and the father asked a woman (whose identity is not known) to look after the baby while he and the older children went to stay with his mother. The baby is reported to have been well but one morning was discovered dead in its cot.

Housing Conditions

Of the 226 deaths investigated, 198 (88%) were of infants from families living in tenement flats, there being 130 (89%) in Group A and 68 (85%) in Group B. The related figure for live births in Glasgow is 80%.

One hundred and three (46%) deaths were infants from families living in only one or two rooms, the proportions in Group A and B being 46% and 45%, respectively. These rates are higher than the overall rate of 40% for Glasgow live births in 1970.

Eighty-two families (36%) had the use of only an outside toilet, the proportions in Groups A and B being 39% and 31%, respectively. 122 families (54%) had only a basin for washing purposes—56% in Group A and 51% in Group B.

In the 190 homes visited, heating facilities were judged to be inadequate in 27 houses (14%)—18% in Group A and 7% in Group B. Among the families investigated by interview, 29 (15%) lived in houses which were verminous—19% in Group A and 7% in Group B.

Seventy-one deaths (31%) were in families whose accommodation was occupied by 5 or more persons (including the deceased infant)—30% in Group A and 34% in Group B. The proportions in each of the leading causes in Group A were similar, but there are no comparable data available for all live births.

Season of Death

The numbers of deaths in the four quarters of the year were 71, 44, 47, and 64, respectively. This trend is due largely to the seasonal distribution of deaths in Group A, deaths attributed to SIDS, pneumonia, and aspiration being greatest in the first quarter and those due to gastroenteritis in the last quarter.

Age of Infant at Death

The age distribution is shown in Table IV. 51 deaths (23%) occurred in the first month (excluding the first week) and a further 72 (32%) before the end of the third month. Only 31 deaths (14%) occurred after the age of 6 months.

Groups A and B differed strikingly, the peak in the former being in the third month and in the latter in the first month. In SIDS, the peak occurred in the second and third months but deaths from pneumonia (three-quarters of which occurred before 6 months) did not show this striking pattern. The overall trend in Group B was due to high mortality in the first and second months from malformations, prematurity, and birth injury.

Place of Death

Half the deaths (113) occurred at home and an equal number in hospital (Table V), though the proportions of home deaths were considerably higher in Group A (73%) than in Group B (9%).

All SIDS deaths occurred at home, the proportions of other Group A deaths at home being—pneumonia, 78%; gastroenteritis, 25%; and aspiration, 88%.

Of the 113 hospital deaths, 65 were of infants admitted from home. Among these, 26 deaths occurred on the day of admission. In Group A, 22 of the 35 infants admitted to hospital died on the first day.

Medical History of Group A Deaths

Among the 127 Group A cases for which full information is available (Table VI), there was a history of a previous illness (excluding the terminal illness) in 65 (51%), the most frequent conditions being upper respiratory tract infection (in 42) and gastroenteritis (18).

There was a history of a terminal illness in 73 (58%), the proportion varying according to the cause of death, namely 32% in SIDS, 64% in pneumonia, and 92% in gastroenteritis. The common symptoms were 'child off its food' (33), vomiting (30), diarrhoea (29), upper respiratory infection (26), pallor (25), cough (23), and fever

TABLE IV
Age at Death

Group	Cause	Age at Death (completed months)								All Ages
		0*	1	2	3	4	5	6-8	9-11	
A	SIDS	3	12	11	8	4	7	2	0	47
	Pneumonia	1	5	6	6	7	2	5	4	36
	Gastroenteritis	7	5	6	3	4	1	0	2	28
	Other infection	2	0	0	0	0	2	2	2	8
	Aspiration	2	2	6	4	1	1	0	0	16
	Others	3	0	1	1	2	0	2	2	11
	Total	18	24	30	22	18	13	11	10	146
B	Prematurity	6	0	0	1	0	0	0	0	7
	Birth injury	3	0	0	0	0	0	0	0	3
	Malformation	22	14	4	8	5	1	5	3	62
	Others	2	0	0	1	3	0	1	1	8
	Total	33	14	4	10	8	1	6	4	80
All deaths		51	38	34	32	26	14	17	14	226

*First-week deaths have been excluded from this study.

(19). In SIDS the most common illness was an upper respiratory infection, though two-thirds of the deaths from this cause were apparently unheralded.

The duration of the terminal illness was less than 4 days in 46 cases (36%), being less than a day in 21 (17%).

In 43 cases (34%), some form of drug therapy had been given at home during the terminal illness, the most frequent being an antibiotic (22). 42 (33%) infants had been under general practitioner

care during the terminal illness, including 4 who died of SIDS, 14 who died of pneumonia, and 13 who died of gastroenteritis.

'Cot Deaths'

There were 103 deaths in which the baby was discovered dead, usually in its cot or pram. These have been designated 'cot deaths'. Only 47 were due to SIDS, the causes in the remainder being pneumonia (25), aspiration of stomach contents

TABLE V
Place of Death and Period in Hospital

Group	Cause	All Deaths	Place of Death		Admitted from Home	Interval Between Admission to Hospital and Death		
			Home (cot deaths in brackets)	Hospital		1st day	Rest of 1st wk	Later
A	SIDS	47	47 (47)	0	0	0	0	0
	Pneumonia	36	28 (25)	8	8	5	2	1
	Gastroenteritis	28	7 (6)	21	17	7	6	4
	Other infection	8	2 (0)	6	5	5	0	0
	Aspiration	16	14 (14)	2	2	2	0	0
	Others	11	8 (5)	3	3	3	0	0
	Total	146	106 (97)	40	35	22	8	5
B	Prematurity	7	1 (1)	6	0	0	0	0
	Birth injury	3	0 (0)	3	3	1	2	0
	Malformation	62	2 (1)	60	25	3	10	12
	Others	8	4 (4)	4	2	0	0	2
	Total	80	7 (6)	73	30	4	12	14
All deaths		226	113 (103)	113	65	26	20	19

TABLE VI
History of Illnesses in Group A Deaths (no Predisposing Organic Disease)

Cause of Death	SIDS	Pneumonia	Gastro- enteritis	Other Infection	Aspiration	Others	Total
Deaths investigated by interview	41	33	25	8	13	7	127
Previous illnesses:							
Any illness	20	20	11	6	5	3	65
Upper respiratory infection	13	15	8	1	4	1	42
Bronchitis or pneumonia	4	5	1	0	0	0	10
Gastroenteritis	6	6	3	1	2	0	18
Other	11	7	2	6	3	2	31
Terminal illness:							
Fever	13	21	23	8	7	1	73
Pallor	1	7	5	4	2	0	19
Diarrhoea	0	5	12	3	4	1	25
Vomiting	3	7	17	0	2	0	29
Upper respiratory infection	1	11	12	2	4	0	30
Cough	6	12	3	2	3	0	26
Off its food	4	8	7	1	2	1	23
Duration (dy) <1	4	8	12	4	4	1	33
1-3	3	6	5	6	1	0	21
4+	5	6	8	1	4	1	25
Drug therapy at home:							
Aspirin	8	15	14	4	5	0	43
Antibiotic	0	2	0	1	0	0	3
Cough mixture	3	6	7	2	4	0	22
Other	3	0	1	1	0	0	5
Visits by or to general practitioner							
: 1	2	9	7	2	4	0	24
: 2+	2	5	6	2	3	0	18

(14), gastroenteritis (6), suffocation (5), miscellaneous (6).

In Group A, the times of certain events (last feed, child last seen alive, and discovery of the death) are known for 79 of the cot deaths (Table VII). Most of the babies were last fed between 9 p.m. and midnight (42 cases) and were last seen alive between 11 p.m. and 2 a.m. (41 cases). Death was usually discovered between 8 a.m. and 11 a.m. (54 cases).

The interval from the last feed to the discovery of death (F-D) varied from 1 to 16 hours, with a

peak at 12 hours. The interval from the baby last being seen alive to discovery of the death (S-D) varied from 1 to 13 hours with peaks at 1 hour and 9 hours. The mean F-D interval was 8.9 hours (SD 3.8), ranging from 4.8 hours in suffocation deaths to 11.5 hours in aspiration deaths; the mean S-D interval was 6.4 hours (SD 3.4), ranging from 3.0 hours in suffocation deaths to 7.0 hours in pneumonia. The following typify cases in this 'cot death' group.

Case 91. *Bronchopneumonia at 6 weeks.* When 5

TABLE VII
Intervals (Hr) from Last Feed and from Last Seeing Child Alive to Discovery of Death in 79 Cot Deaths

Cause of Death	No. Interviewed	Time From Last Feed		Time From Last Seen Alive	
		Range	Mean (SD in brackets)	Range	Mean (SD in brackets)
SIDS	38	1-16	8.6 (3.7)	1-13	6.6 (3.2)
Pneumonia	23	1-14	9.3 (3.6)	1-12	7.0 (3.8)
Gastroenteritis	4	3-11	9.0 (3.3)	4-10	6.8 (2.7)
Aspiration	9	6-13	11.5 (3.6)	1-12	6.2 (3.4)
Suffocation	5	1-11	4.8 (4.1)	1-8	3.0 (2.9)
All cot deaths	79	1-16	8.9 (3.8)	1-13	6.4 (3.4)

weeks old the baby had diarrhoea and was hoarse when she cried; the general practitioner prescribed capsules for inhalation. The baby seemed to improve and one morning about a week later she was given a feed at 4 a.m.; the family slept until 2 p.m. when the mother found the child dead in her pram.

Case 227. SIDS at 5 months. After his 9 p.m. feed, the baby lay awake contentedly until 10.30 p.m. and seemed all right when seen at 1 a.m. The father came in from work at 9 a.m. but did not look at the baby. (Normally he fed the baby and dressed the older child who, on this occasion, was asleep.) Waking at 11.25 a.m. the mother found the baby was blue and resuscitation attempts by ambulance staff were unsuccessful.

Of the 80 deaths in which we know the baby's position when found, 12 were found covered with

bedclothes and 11 were lying face down; 5 were thought by the parents to have been overlain (three deaths attributed to SIDS and two to pneumonia).

Among the 97 cot deaths investigated in Group A, there was no clear trend in the day of the week on which the death was discovered. SIDS showed a peak on Tuesdays followed by a falling off to Saturday. In pneumonia deaths, there was a peak on Fridays.

A comparison of the mean and minimum air temperatures on the days when SIDS and pneumonia cot deaths occurred with quarterly air temperatures provided no evidence to suggest that the air temperature in itself was a causative factor in such deaths.

TABLE VIII
Avoidable Factors Among 199 Deaths Investigated in Detail

Avoidable Factors	Group A	Group B	All Deaths
<i>Social</i>			
Housing	75	20	95
Family situation	49	8	57
Other	4	0	4
Any of this group	88 (69)	21 (29)	109 (55)
<i>Parental</i>			
Mental subnormality	10	0	10
Neglect	21	1	22
Incompetence	36	1	37
Failure to summon medical aid	15	2	17
Failure to appreciate seriousness of situation	22	6	28
Wilful neglect	3	0	3
Other	1	0	1
Any of this group	51 (40)	7 (10)	58 (29)
<i>General practitioner</i>			
Slowness in reference to hospital	3	1	4
Diagnostic delay or failure	3	2	5
Failure to realize severity of situation	11	1	12
Delay in visiting	7	1	8
Failure to follow up	8	1	9
Other	5	2	7
Any of this group	24 (19)	6 (8)	30 (15)
<i>Hospital</i>			
Diagnostic failure or delay	2	0	2
Management	1	0	1
Early discharge	0	0	0
Hospital infection	0	0	0
Other	0	0	0
Any of this group	3 (2)	0 (0)	3 (2)
<i>Local Health Authority</i>			
Lack of appreciation of child's condition	1	0	1
Failure to ensure sick child seen by general practitioner	1	0	1
Other	0	0	0
Any of this group	1 (1)	0 (0)	1 (1)
<i>Other factors</i>			
Unsafe pillow	2	0	2
Other	2	1	3
Either of this group	4 (3)	1 (1)	5 (3)
Any of above factors	104 (82)	25 (35)	129 (65)

Note: Percentages are shown in parentheses

Avoidable Factors

Using the classification of the Department of Health and Social Security's 'Confidential inquiry into postneonatal deaths, 1964-1966', avoidable factors associated with the deaths investigated were judged to be present in at least 129 (65%) of the 199 deaths for which full information is available (Table VIII)—104 in Group A (82%) and 25 in Group B (35%).

The leading group of avoidable factors was 'social' (109 cases or 55%) being mainly poor housing conditions (95) or adverse family circumstances such as overcrowding (57). 'Parental' factors were present in 58 (29%) and included maternal incompetence (37), failure to appreciate the seriousness of the child's condition (28), neglect (22), and failure to summon medical aid (17). The prevalence of each of these parental factors was far higher in Group A deaths than in Group B: the following illustrative cases may be quoted.

Case 28. *Accidental asphyxia at 11 months.* The mother put the baby in a double bed at 8.30 p.m. but when she went to see it at 9 p.m. the child's neck was found to be jammed between the bed and the wall with the body hanging beneath the bed. The mother's brother tried the 'kiss of life' and when an ambulance arrived (10 minutes later) further resuscitation was attempted but without success.

Case 73. *Gastroenteritis at 2 weeks.* Throughout New Year's Day the baby was off its feeds and had one yellow-black stool. The mother was alone all day with her three children, her husband being at his parents' house for hogmanay. If there had been someone to look after the children she would have consulted her general practitioner. The baby took a small feed at 10 p.m.; the parents went to bed at 11 p.m. and the baby was found to be dead at 9.30 a.m.

Case 179. *Gastroenteritis and dehydration at 4 months.* The baby vomited all day and was irritable. The father thought it would be safe to wait until next morning before calling the doctor. She refused a feed at 9 a.m. and 'seemed to be groaning'. Several attempts around 10 a.m. to contact the general practitioner were unsuccessful and at 2 p.m. the mother took the baby by bus to the hospital where she died that evening.

Deficiencies in medical care were felt by us to have played an important role in an appreciable number of deaths. The following are typical case histories.

Case 20. *Faecal peritonitis due to perforation of caecum at 8 days.* The baby vomited its 11 p.m. feed and did not seem well during the night. The midwife

was still attending and when she called about 10 a.m. she was concerned about the baby's condition and 'phoned the general practitioner. When the father arrived home at 4.30 p.m. and discovered that the doctor had not been, he went out immediately to 'phone the general practitioner and an emergency doctor arrived at 5 p.m. Admission to hospital was arranged but the baby died at 4 a.m. the next day after an operation.

Case 39. *Gastroenteritis at 10 weeks.* When the parents woke at 7.30 a.m. the baby was convulsing and looked very grey. He had seemed well the previous day. The father tried to contact the general practitioner at 8.30 a.m. but was referred from one 'phone number to another, four times in all. In spite of emphasizing that the call was urgent, the doctor did not come. A further 'phone call at 11 a.m. succeeded in bringing an unknown doctor within 5 minutes. She admitted the baby to hospital where she died about 10 hours later.

Case 86. *Meningococcal septicaemia at 7 months.* The mother 'phoned her general practitioner at 5.30 p.m. requesting a visit because the child was pale and had been screaming most of the afternoon. She was told that all calls had to be made before 10 a.m. but that the doctor might visit. The baby's condition worsened and she 'phoned again at 7 p.m. to be told that she should 'phone the doctor's home. She did so but was told that calls could not be accepted at his home. A neighbour who was concerned about the baby 'phoned and stressed the importance of a visit. About 8 p.m. spots appeared on the child's body, but when the doctor arrived at 9.20 p.m. he said 'I don't know what all the fuss is about'. He gave an injection and warned the mother to watch the child 'because he may develop silent pneumonia'.

The baby slept until 11.30 p.m. and then made a choking sound and seemed to stiffen. The mother took the baby to hospital (a passing motorist gave them a lift). After a while, a priest came to tell her that the baby was dead and, after necropsy, the grandmother was told that the child had meningitis and would have been an imbecile had he survived.

Case 204. *Pneumonia at 11 months.* The baby was feverish and off colour for two days and on the next day appeared 'to be in a trance'. He was quiet but took his feeds. In the evening he seemed feverish, drowsy, and had an occasional jerky movement. An attempt to telephone the general practitioner at 10.30 p.m. was unsuccessful and the emergency service apparently said there was no guarantee that a doctor would call. At 1.50 a.m. a doctor called but, without examining the baby, said there was nothing wrong—'only teething and all children have a temperature when teething'. The parents were told to call the general practitioner in the afternoon if they were worried. Later that day the baby seemed very weak and was still drowsy. At 4 p.m. he had a convulsion and the doctor admitted the child to hospital where he died 10 hours later.

Discussion

Approximately two-thirds of the deaths occurring in the study period were in infants with no known underlying organic disease. Among these, deaths of unknown aetiology—the so-called 'sudden infant death syndrome'—were the largest group, followed by pneumonia and gastroenteritis.

Half the infants died at home, the majority being discovered dead, usually in their cots or prams. SIDS was responsible for half the 'cot deaths' and a quarter were due to pneumonia; other causes (in decreasing frequency) were aspiration of gastric contents, gastroenteritis, and asphyxia. Overlaying is now generally discounted as an important cause of cot death, but this was a probable factor in at least 5 cases. A further 12 infants were covered with bedclothes, possibly as a result of vigorous movements immediately before death.

Many of the deaths among infants admitted to hospital occurred on the day of admission, especially in Group A (no known predisposing organic disease). This confirms the strong impression gained while scrutinizing the hospital records that a high proportion of the infants were critically ill at the time of admission, many being moribund; this was one of the most striking and unexpected findings in the investigation.

There was a history of a terminal illness in many of the Group A deaths, being most frequent in gastroenteritis and, though very rapid deterioration can occur in a young child's condition, it is surprising that signs of a terminal illness were not present (or not recognized) in a higher proportion of the infants who died of pneumonia. One-third of the infants in Group A had been under general practitioner care during the terminal illness and the same proportion had received some form of therapy, often an antibiotic, during the illness.

These findings point to the crux of the problem, namely how and why do infants die unexpectedly in their cots or reach such a critical condition that they are beyond hope of recovery when they reach hospital?

The vulnerability of certain groups of infants is clearly seen in this study, e.g. the illegitimate and infants of low birthweight. The excess of deaths in social classes IV and V is also in line with the usual findings (Richards, 1971) and, as expected, this excess was greatest in Group A. Deaths in this group tended to involve the infants of younger mothers and to occur in larger families living in poorer accommodation. Paternal unemployment was common in the families studied, especially in those of Group A. Assessment of maternal intelligence and efficiency, though liable to observer

bias, suggest that in Group A there was an excess of mothers whose intelligence and domestic efficiency were below average.

In their study of morbidity and mortality in the first year of life in 15 areas of England and Wales, Grundy and Lewis-Faning (1967) showed that infants living in bad housing had a mortality rate of almost twice the rate for all children, and that the postneonatal mortality in the infant in the large family was more than double that for the only child. They also showed the importance of standards of maternal care for, though considerable social-class gradients remained after standardizing for housing standards, maternal care, birthweight, family size, and parents' education, the only standardizations that reduced the crude social class gradient substantially were maternal care and birthweight. In discussing the social class gradients in stillbirth and infant mortality rates, Kincaid (1965) remarked that, 'what we are dealing with are not isolated factors but whole patterns of behaviour. And in so far as these factors vary between the various social classes, what are in question are differences between the whole way of life of different sections of the community.'

Attendance at child health clinics and immunization rates give some indication of standards of parental care. In Glasgow, about 60% of infants attend a child health clinic at least once in the first year (Richards, 1971), yet among Group A deaths, two-thirds of the eligible infants had not attended at all. Likewise, two-thirds of young children in Glasgow receive a complete course of triple antigen and poliomyelitis immunization; but infants dying of Group A causes had a poor immunization status, 72% of those eligible having received no immunization at all.

Weekends might be expected to be associated with an increased mortality from avoidable causes. There is strong evidence of a high home accident rate in Glasgow on Friday nights and the increased weekend drinking and longer lying-in in the mornings should predispose to a raised infant mortality. However, there was no evidence of such a trend; in fact, SIDS deaths were lowest on Friday nights.

The incidence of SIDS in this study (2.7 cases per 1000 live births) is similar to the rate of 2.5 to 3.0 per 1000 in Northern Ireland (Froggatt, Lynas, and MacKenzie, 1971) but double the estimated frequency of 1.4 per 1000 in England and Wales (Ministry of Health, 1965). The sex, age, seasonal, and social class patterns of SIDS deaths are also similar to those reported by Froggatt *et al.* (1971). So, too, is the history of an apparently minor illness

in a significant proportion of the infants during the week before death. In a study of this problem in Salford, Vaughan (1968) found that many of the children were seriously ill for some time before death. This fact was often not appreciated by the parents or, as in more than half the cases, the mother had been unable to discuss the child's condition with the father on the evening before the child died—because of marital disharmony, separation, or night work. Serious family problems, such as very tense marital relationships or illegitimacy, were present in one-third of the Group A deaths in our study, being particularly prevalent (67%) in SIDS.

The long interval elapsing in many cot deaths between seeing the child alive and the discovery of its death appears to be a hitherto unreported finding. Whether it is directly related to the death is not known; what it must surely reflect is the suboptimal standard of parental care in many of these families.

The identification of avoidable factors is not always easy and the histories recorded in this paper are largely parental accounts which could not always be verified from other sources. However, the high prevalence of poor social conditions accompanied by high unemployment and illegitimacy rates and much family stress are not unexpected in a study of infant mortality in a large underprivileged industrial city. The correction of these deficiencies rests heavily on economic aid, massive housing redevelopment and family planning programmes. Suitable health education and parent-craft teaching, especially for schoolgirls, and a large increase in the seriously depleted health visiting force are further important needs.

The early recognition of serious illness in a young child, access to good medical care, the ability to communicate effectively with the general practitioner, and correct action on his part are all important prerequisites for a satisfactory outcome. This study, conducted in an area of high infant

mortality, suggests that deficiencies in these factors, often in combination, played a large role in many of the deaths investigated.

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Detailed tabulation of the results is available from I.D.G.R.