POST-NEONATAL DEATHS IN BAOR 1971-1979

MAJ R W J SMITH, MB, BCh, MSc, MFCM, MRCP, DObstRCOG, RAMC

Headquarters 1 (Br) Corps, BAOR

SUMMARY: The incidence of post-neonatal death in the British Army of the Rhine (BAOR) for the years 1971 to 1979 inclusive is described. The rate fell from 1971 to 1976 but then rose to its previous levels by 1979. No conclusion can safely be drawn from this disappointing rise. The majority of deaths occurred at home, in the winter months and in the families of the lower ranking soldiers. A small peak in the summer months is noted similar to that experienced in the Netherlands; the cause is not known. The results of a case control study are given and a scoring system designed to recognise high risk babies is described,

Introduction

The Court report¹ published some five years ago stimulated a continuing discussion of the morbidity and mortality of children. It engendered most discussion with its recommendations for the re-organization of medical services to provide an enhanced level of care for children; however it also highlighted the fact that disease and death rates in the United Kingdom (UK) were unacceptably high in comparison with some other European countries.

At about the time of the Court report, Maj R O Walters, RAMC (now Lt Col) began to collect data on post-neonatal deaths in BAOR and concluded (*personal communication*²) that there was prima facie evidence of a high post-neonatal death rate. After discussion with Lt Col Walters the present study was designed with two objects in mind:

- a. To quantify accurately the post-neonatal death rate in BAOR, to examine the cause of death and thereby to determine what proportion might have been, and might be, prevented.
- b. To create a scoring system whereby those children at high risk of post-neonatal death might be recognized at birth and offered additional care and supervision³.

Methods

The post-neonatal death rate is calculated as the number of children dying between the ages of 28 days and 364 days in any one calendar year, divided by the number of live-born children born in the same year in the same population:

For example —

$$\frac{\text{Number of children dying between the ages of 28 to 364 days}}{\text{Number of live-born in the same population}}$$

The numbers of children dying in any one year were obtained from the records of the Department of Manning Information Data Processing, (MAN IDP)

and from post-mortem records. The denominator population figures were obtained from:

a. Soldiers', Sailors' & Airmen's Families Association (SSAFA) records of visits to new-born. b. Service hospital registers. c. Monthly statistical returns submitted by hospitals (AF W3166).

Two other sources were sought, namely personnel records at Worthy Down, and Her Majesty's Consulate at Dusseldorf and Hannover. These were rejected as being unsuitable or too difficult to obtain in the time span.

The second part of the study, that is, the creation of a scoring system, was to take the form of a case-control study. The infants chosen as cases were those:

a. Dying between one month and one year. b. Who were born in BAOR and who died in BAOR. c. For whom information was available on the age and cause of death. d. Who died from what were considered to be preventable causes. e. For whom adequate controls were available.

Two controls were chosen for each case. The criteria for the selection of the control babies were:

- a. They were alive on their first birthday.
- b. That they were born in the same hospital (see below).
- c. That they were the two children born next in succession to the index case.
- d. Where notes were not available for the first or second choice of control a third choice was made of the next birth in succession.
- e. If the infant was born in a Krankenhaus the two babies chosen as controls were selected at random from the register of babies born on the same day in the hospital in which the case baby would normally have been born.

The sources of data for the case-control study were:

a. F Med 198 — Antenatal record. b. F Med 199 — Record of labour. c. F Med 10 and 11 — Hospital admission forms and continuation sheets. d. Birth weight charts. e. Nursing notes. f. SSAFA sister child health/visting records.

Confirmation of demographic data was obtained by writing to the Records Office of respective fathers. In addition to the documentary data, a questionnaire was constructed to obtain information on housing from Station Officers (SSOs).

The purpose of the case-control study was to examine as many variables as were considered possibly to affect the well-being of an infant in the first year of life^{3, 4}. Thus the construction of the coding schedule of the case-control study fell into seven main categories:—

- (a) Details of mother, including age at first pregnancy and marital status at conception of index pregnancy.
- (b) Details of father, including age, rank and unit.
- (c) Social factors including type of dwelling, distance from hospital and SSAFA sister/patient ratio. Information on factors such as smoking and alcohol would have been useful but data were insufficiently well recorded to be of worth.
- (d) Antenatal history; including details of when antenatal care started, results on first examination, the haemoglobin value when first taken,

- blood group, complications of pregnancy and admission to hospital during pregnancy. The quality of antenatal care has been shown to affect the possibility of post-neonatal death⁴.
- (e) Details of labour and delivery, including whether induced or otherwise.
 - (f) Details of the new-born including birth weight³, state of development, APGAR score, need for resuscitation, neonatal illness and rate of weight gain.
 - (g) Post-natal history including method of feeding⁴, whether mother took her own discharge, and whether there was any rapport between child and mother.

The questionnaire comprised 61 variables in all and was pre-coded for transfer to punch cards. The analysis of the data collected for the case-control study was by Chi square test for non-continuous variable, the Student 'T' test for continuous variables normally distributed and Wilcoxon's Rank Sum test for non-normally distributed data.

The scoring system was obtained using stepwise discriminant analysis of those variables in which a significant difference between cases and controls was demonstrated⁵.

Results

Calculation of rates

There was considerable discrepancy in the figures for the denominator population depending on which source was chosen (Table I). The source chosen finally was the SSAFA Quarterly Return; it was felt that this figure was more likely to be appropriate because it includes babies born out of Service Hospitals to both British and German national mothers. It has one fault which is that an, as yet unknown, proportion of babies born in the UK and migrating to BAOR are included.

Table I
Details of number of live births as recorded by two different sources
BAOR 1971 to 1979

Year	SSAFA quarterly returns	Hospital returns	Difference	Percentage difference
1971	4605	4210	395	8.5
1972	4218	4016	202	4.7
1973	4406	4109	297	7.2
1974	4100	3725	375	9.1
1975	4097	3717	380	9.2
1976	3888	3426	462	11.9
1977	3824	3400	424	11.1
1978	3922	3645	277	7.1
1979	3879	3452	427	11.0

Similar but smaller discrepancies occurred in the numerator figures (Table II) in each instance the larger figure was adopted. That chosen for the numerator population was, with the exception of 1972, obtained from MAN IDP.

Table II
Post-neonatal deaths BAOR 1971 to 1979 inclusive

	1971	1972	1973	1974	1975	1976	1977	1978	1979
Numbers recorded on F Med 161	39	30	37	29	23	20	22	26	27
Numbers notified to MAN IDP	41	29	38	32	28	21	23	32	33

The rates calculated from the above figure are shown in Table III with the UK figure given for comparison. It will be noted that after a steady downward progression to 1976, the post-neonatal death rate has risen dramatically to levels similar to those obtaining in the early 1970's. This disappointing result has occurred in the absence of any obvious precipitating factors such as especially severe weather, radical restructuring of medical services, or changes in the social/demographic character of the military population.

Table III
Post-neonatal mortality rates BAOR and UK 1971 to 1979

	1971	1972	1973	1974	1975	1976	1977	1978	1979
United Kingdom	5.9	5.8	5.8	5.5	5.1	4.6	4.6	4.5	
British Army of the Rhine	8.9	7.1	8.6	7.8	6.5	5.4	6.0	8.2	8.5

Causes of death

The causes of death by ICD groupings (Table IV) show that the majority of deaths fell into the Sudden Infant Death Syndrome (SIDS) category. Not only is there a disparity between BAOR and the UK in the proportion of children dying from 'cot' deaths, but there is, in addition, a difference in the proportion of children dying as a result of disease of either the respiratory, or other major organ systems Emery⁵ proposed an alternative system of categorizing the causes of death. He sub-divided causes of death into four major categories:

Category A — Children with gross congenital deformities, with disease of long standing in whom early death was probably inevitable and could be precipitated by minor disease.

Category B — Children in whom a definite disease state is found, a disease that is frequently diagnosed and treated at home or in hospital.

Category C — Children who reveal evidence of disease which does not actually result in a significant mortality rate, for example, upper respiratory tract infection, mild gastro-enteritis and small areas of pneumonia from which most children recover.

Category D — (a) Children who die with evidence of general metabolic upset indicative of chronic hypoxia or non-specific disease. (b) Children who die with no evidence of disease.

If using Emery's Classification we compare the distribution of deaths in BAOR with what would be expected in the UK, given no expert paediatric

Table IV
Causes of deaths in BAOR and UK

ICD No 1971-74 Classification	Disease description	Number of deaths	Deaths as a proportion of total	
			BAOR	UK (1)
460-519	Respiratory	73	27.6%	34.6%
000-136	Infective & parasitic	6	13.6%	30.4%
008-009	Enteritis & other diarrhoeas	4		
140-209	Malignant neoplasm	0		
320-389	CNS & sense organs	16		
E980-E949 } E908-E989 }	Accidents	9	8.6%	21.4%
740-759	Congenital abnormalities	23		
795	Sudden infant deaths	133	50.2%	13.6%

(1) 'Court' report — *Fit for the Future* — the report of the Committee on Child Health Services HMSO 1976

necropsy service (Table V), we find that the previously noted disparities are repeated. However, it should be noted that Category A deaths may be artificially reduced due to the fact that many children with severe congenital disease are evacuated to UK from BAOR.

It would appear, therefore, that more infants die from 'cot' deaths in BAOR than in UK. The reasons for this are discussed below.

Table V
Distribution of deaths using Emery's classification

	Category				
	A	B	C	D	C and D
Percentage distribution UK	33.3	33.3			33.3
Percentage distribution BAOR	9.8	33.7	4.0	52.7	56.7

Epidemiology

The age distribution of children dying in BAOR is to be found at Table VI. When we separate the 'cot' deaths from those deaths in which some pathology could be demonstrated, we note that a significantly greater proportion of children falling into the 'cot' death category died before the age of five months than in the other categories.

The distribution of deaths by rank of father demonstrates an excess of deaths in the families of Corporals and below (Table VII). This substantially mirrors the same state of affairs that exists in the UK, with the caveat that the rank distribution in BAOR is not really comparable with the social class structure of the UK, principally because rank is such a complex variable, including as it does within any one rank, persons of differing abilities, age and aspirations. When we examine the breakdown of deaths by fathers' Arm or Corps, we note (Table VIII) that the Infantry suffer a disproportionately larger number of deaths than

Table VI
Distribution of deaths by age and pathology category

Age (months)	A, B and C			Pathology category D		
	Numbers	Percentage	Cumulative percentage	Numbers	Percentage	Cumulative percentage
1	17	13.6	13.6	21	15.2	15.2
2	24	19.2	32.8	35	25.4	40.6
3	22	17.6	50.4	38	27.5	68.1
4	9	7.2	57.6	20	14.5	82.6
5	14	11.2	68.8	8	5.8	88.4
6	9	7.2	76.0	10	7.2	95.6
7	16	12.8	88.8	2	1.4	97.0
8	4	3.2	92.0	3	2.2	99.2
9	0	0	92.0	1	0.7	99.9
10	0	0	92.0	0	0	99.9
11	10	8	100.0	0	0	99.9

Table VII
Distribution of death by rank of fathers

Rank	Cause of death (by Emery's classification)				Proportion of BAOR population
	All causes Numbers	percentage	'D' deaths Numbers	percentage	percentage
Corporal & below	233	89.6	124	88.4	58
Sergeant & above	21	8.1	11	9.4	32
Captain & below	3	1.2	2	2.2	4.6
Major & above	3	1.2	0	0.0	4.7

Table VIII
Distribution of death by Arm/Corps

Arm	Proportion of deaths (percentage)	Proportion of live births (percentage)
Infantry	28	20
RA/RAC	24	22
Others	48	58

other 'Teeth' Arms or the Service Corps. Why this should be so is largely a matter for conjecture, it may be because Infantrymen are, more than other Arms or Corps liable to frequent posting and disruption.

There was an excess of male deaths over female deaths to the ratio of 1.3:1. The excess of male deaths is an almost universal finding, but not to quite such a large extent⁶.

The seasonal variation of post-neonatal deaths is shown in Figure 1. It is

interesting to note the slight rise in death rate over the mid-summer months. This finding is similar to that noted by Baak and Huber⁷ in the Netherlands where it was attributed to accidental suffocation. However in view of the recent interest shown in hyperpyrexia as a cause of post-neonatal death^{8, 9}, it may be that we are missing an attributable cause of death by either failing to note the bedding or clothing or not routinely examining for post-mortem changes suggestive of hyperpyrexia. The drop in the death rate in December is thought to be due to migration to the UK on holiday.

Fig 1. Monthly distribution of post-neonatal deaths

Fig 2. Daily distribution of post-neonatal deaths

The distribution of deaths throughout the week (Fig. 2) demonstrates that a greater number of deaths occur on Thursdays, Fridays, Saturdays and Mondays. This distribution suggests that, at least in the Army Medical Services, the substitution of emergency services during weekends plays little part in the incidence of post-neonatal deaths¹⁰.

A number of children were discovered to be dead by their parents on waking, a finding which is consistent with other studies on infant deaths⁶.

There was a majority of children who died at home (Table IX), a finding which is consistent with the necropsy results and a lowered threshold of suspicion by parents that their children may be ill. This is not however a result common to all studies of post-neonatal death¹¹.

Table IX
Place of death

Place of death	A	B	C	D	Total	Percentage
Hospital	8	12	2	2	24	9.2
Home	19	72	7	137	235	89.6
Other	0	2	0	1	3	1.1

Morbidity and symptoms

About one third of babies dying between one month and one year of age died as a result of significant pathology, that is, there was a sufficient disease state found at necropsy to account for the baby's death. It would therefore seem reasonable to expect some of these children to have exhibited symptoms before death. Table X gives the breakdown of the occurrence of symptoms in babies before death. If we examine further what action parents took as a result of noting these symptoms (Table XI), we find that even when infants demonstrated severe symptoms fewer than half their mothers sought advice.

Table X
Analysis of symptoms by severity

Analysis of symptoms by severity	Proportionate frequency
Nil of note	42%
Mild (snuffles, respiratory tract infection, etc)	27%
Moderate (respiratory tract infection, cough, etc)	17%
Severe (high fever, dyspnoea)	5%
No history available	9%

Table XI
**Proportion of each category of symptom severity
that sought medical advice**

Severity of symptoms	Proportion seeking medical advice
Mild	20%
Moderate	40%
Severe	40%

Case-control study

The results of the case-control study are to be found in Tables XII, XIII and XIV. Of the 61 variables examined, 14 demonstrated a significant difference at the 5% level by comparison with the controls: These were:

- (a) Rank of father — the families of lower ranks experienced significantly more deaths than the families of non-commissioned and commissioned officers.
- (b) Complication of pregnancy — the 'case' population had a greater proportion of abnormal pregnancies.
- (c) Admission to hospital — almost twice as many of the 'case' mothers were admitted to hospital during pregnancy as 'control' mothers.
- (d) There was an excess of male deaths over female deaths of 'case' babies.
- (e) Oxygen therapy — that this variable demonstrated a difference between 'cases' and 'controls' came as a surprise. It is even more surprising that 'control' babies should have received oxygen more frequently than 'case' babies, although this tends to agree with the finding (Table XII) that a smaller proportion of low APGAR score babies was found amongst the 'cases' than 'controls'.

Table XII
RESULTS OF QUALITATIVE VARIABLES

Variable	Coverage of information %	Cases %	Controls %	Difference	Significance (χ^2 test)
Marital status of mother	99.7	99	100	1	
Marital status at conception	97.9	91	94.7	3.7	
1+ previous child deaths	98.65	8.1	5.6	2.48	
Oral contraception	44.63	80.4	74.7	5.7	
Rank of father (CPL and below)	99.3	91.9	74.1	17.8	XXXX
Father in 'teeth' arm	95.9	57.1	49.4	7.7	
Posting	90.9	53.3	44.2	9.1	
Missed A/N attendance	92.9	14.1	12.4	1.7	
1+ abnormal pregnancy	97.9	35.7	24.2	11.47	X
Satisfactory 1st examination	94.2	97.87	96.8	1	
Blood group 'C'	99.3	52.04	44.4	7.59	
'A'	"	35.7	40.9	5.2	
'B'	"	10.2	10.1	0.1	
'AB'	"	2.04	4.5	2.5	
Rhesus positive	99.3	84.7	82.3	2.4	
Rhesus antibodies	"	1.02	1.01	0.01	
Anaemia	100	19.4	8.72	10.7	X
No complications of pregnancy	98.6	42.4	61	18.6	XXX
Admission to hospital	98.9	51.5	26.5	25	XXXX
Drugs other than iron	97.9	32.6	60.4	2.2	
Illness on final admission	98.7	15.15	9.74	5.4	
Induced labour	92.7	55.8	58.5	2.7	
Meconium staining	81.8	11.25	8.22	3.03	
Maternal distress	95.3	7.7	10.8	3.1	
Foetal distress	92.6	6.6	4.7	1.9	
Malpresentation	96.9	3.2	4.1	0.9	
Forceps delivery	97.9	6.25	2.04	4.2	X
Multiple pregnancy	100	3	.005	2.495	X
Analgesia in labour	97.3	12.6	14.3	1.7	
Sedatives in labour	97.6	15.8	16.8	1	
Anaesthetic	97.9	24.2	21.4	2.8	
Male sex	100	59	44	15	XX
Congenital anomaly	98.9	3	5.6	2.6	
APGAR score below 5	96.9	5.3	7.7	2.4	
Illness in neonatal period	94.9	47.7	43.5	4.2	
Resuscitation	96.6	5.3	4.6	0.7	
Incubation	96.6	7.5	10.2	3.8	
Oxygen therapy	96.9	15.8	27.3	11.5	XX
Prematurity by age	100	12	6.5	5.5	
Took own discharge	98.3	6.18	1.5	4.68	XX
Breast feeding	97.9	11.4	27.5	16.15	XXX
Poor rapport mother/child	96.6	3.15	1.55	1.6	
Living in hiring	84.5	9.2	9.0	0.2	
Living in a flat	75	75	73	2	
SSAFA Sister/pop ratio greater than 1:1500	78.9	40.2	41.7	1.5	
Membrane ruptured more than 24 hr before delivery	75.8	7.4	3.3	4.1	X
Born out of hospital	100	6	1	5	XXX

Note: XXXX = p .001 XXX = p .01 XX = p .05 X = p .1

- (f) Mother discharging herself — the mothers of 'cases' took their own discharge more often than the mothers of 'controls.'
 - (g) Feeding — a greater proportion of mothers of 'controls' breastfed their babies.
 - (h) Born out of Service hospital — although the numbers are small, a far greater proportion of 'case' infants were born in a Krankenhaus, in a clinic/medical reception station or in transit, than 'control' infants.
 - (i) Age of mother
 - (j) Age at marriage
 - (k) Age at 1st pregnancy
- These three variables illustrate the association of the age of the younger mother to the death of her child. When parity is examined with age, the effect is more noticeable (Table XV).
- (l) Birth weight — the 'case' babies were on average half a kilogram lighter than 'control' babies.
 - (m) Regain of birth weight before discharge — the coverage of information for this variable was comparatively restricted, but this restriction was shared equally amongst 'cases' and 'controls.' It was felt therefore that no bias existed to prevent its inclusion in the case-control study. The slowness of weight gain in the cases was felt to be a reflection of apparent immaturity.
 - (n) Length of stay as an in-patient during pregnancy — not only were 'case' mothers admitted to hospital more frequently than 'control' mothers, they also remained as in-patients for a greater length of time. It is not known whether this reflects a greater incidence of more severe ante-natal disease, or whether there were social reasons for not returning the mother to domiciliary care.

The following six variables demonstrated a difference between 'cases' and 'controls' at the 10% level:

- (a) Abnormal pregnancy — a greater percentage of 'case' mothers experienced one or more abnormal pregnancies than 'control' mothers.
- (b) Anaemia — low haemoglobin levels were more prevalent in 'case' mothers than in 'control' mothers.
- (c) Forceps delivery — three times as many of the 'case' infants were delivered by forceps delivery than 'controls.'
- (d) Multiple pregnancy — the incidence of multiple pregnancy was greater in 'case' pregnancies than 'control' pregnancies.
- (e) Rupture of membranes — a greater proportion of 'case' mothers experienced an early rupture of membranes than 'control' mothers.
- (f) Second stage of labour — the median length of the second stage of labour in 'case' labours was shorter by almost five minutes than in 'control' labours. This perhaps contradicts the earlier finding that 'case' babies had a greater incidence of forceps delivery, although it may reflect a need for intervention which might explain both the reduced length of second stage labour and instrumentation.

Table XIII
Results of quantitative variables for normally distributed variables

Variable	Coverage of information %	Mean		Difference	Significance (students 't' test)
		Cases	Controls		
Age of mother	99.6	21.6 yr	24 yr	2.4 yr	xxxx
Age at marriage	96.3	18.6	20.5	1.9	xxxx
Age at 1st pregnancy	68.79	18.7	20.7	2.0 yr	xxxx
Length of pregnancy at 1st examination	96.3	16.4 wk	16.6 wk	.2 wk	
Length of pregnancy at labour	93.9	38.8 wk	39.3 wk	.5 wk	
Birth weight	99.6	2.8 kg	3.2 kg	.5 kg	xxxx
Head circumference	43.2	34.46 cm	34.56 cm	.1 cm	

Table XIV
Results of quantitative variables not normally distributed

Variable	Coverage of information %	Median		Difference	Significance (Wilcoxon signed rank sum test)
		Cases	Controls		
Haemoglobin	96.9	11.28 gm	11.26 gm	.02	
Length of stay in hospital during pregnancy	98.3	2.4 d	1.9 d	.5 d	xxx
Regain of birth weight before discharge	41.3	6.95 d	5.45 d	.5 d	xxx
Length of 1st stage labour	89.9	5.35 hr	5.14 hr	.21 hr	
Length of 2nd stage labour	89.9	13.9 min	18.6 min	4.7 min	x
Parity	98.9	1	1	—	
Distance from hospital	97.3	15 km	30 km	15 km	

Table XV
Percentage of mothers in the case-control study experiencing the death of an infant within age/parity groups

Age in years	Parity							
	0	1	2	3	4	5	6	7
18	40	86	—	—	—	—	—	—
19	18	33.3	75	—	100	—	—	—
20	36	44	50	—	—	—	—	—
21	0	38	75	100	—	—	—	—
22	16.6	44	33	0	—	—		
23	0	18	44	0				
24	50	15	80	0	60	0		
25	20	18	38	0	0	0	100	—
26	16	10	8.6	25	40	33	—	0

Scoring system

The variables selected to form the basis of the scoring system were as follows:

<i>Variable</i>	<i>Co-efficient</i>	
Mother's age		
Urinary infection during pregnancy		
Length of 2nd stage of labour		
Twin birth	*.0023	(*indicates those variables not demonstrating a significant difference between cases and controls at the 5% level).
Birth weight*		
Feeding intention		
Parity*		
Blood group A*		
Where born	*.47747	
Length of stay in hospital during pregnancy	*.01293	

It should be noted that some of the variables included in the scoring system did not reach significant levels in the case-control study. The reason for their inclusion is that while experimenting with the variables which demonstrated significant differences, it was decided to include the 'Sheffield' variable³ (see above) in order to determine whether it had any validity within a BAOR study. Somewhat surprisingly it proved to be a very potent predictor and hence was included. The purpose of the scoring system is to identify those children considered to be at high risk. The selection of the 'cut off' point is a function of optimum specificity ie, the extent to which those at low risk are recognised as such. The reason for choosing specificity as the main parameter for the cut off point is that the system is not predictive and some cases will occur with low risk scores. If we were to choose a highly sensitive score, we might just as well provide the same 'extra' care to all babies and hence obviate the need for such a scoring system. Thus:

TEST			
True	Positive	a	b
	Negative	c	d
		Sensitivity = $\frac{a}{a + c}$ Specificity = $\frac{b}{b + d}$	

The relative risk is calculated as the ratio of Sensitivity to Specificity

$$\text{ie, } \frac{\frac{a}{a + c}}{\frac{b}{b + d}} = \frac{ab + ad}{ab + bc} = \frac{ad}{bc}$$

The scoring system as evolved in this study has been adapted and applied by Lt Col Holmes-Smith currently serving as Command Consultant Adviser in Paediatrics in BAOR.

Discussion

The first reported study of Infant Mortality was a computer study of Sudden Infant Deaths in BAOR undertaken between 1971 and 1973 by the then Deputy Director of Army Health in BAOR, Col (Later Brig) W S Millar L/RAMC. Sadly the results were not published, but they did suggest that levels of infant mortality in BAOR were disturbingly high. A Medical Administrative and

Technical Instruction had been issued in 1968 advising that 'cot' deaths might be prevented by paying more attention to the heat and humidity levels of bedrooms, thus suggesting that some of these deaths resulted from overheating. Despite these initiatives little has been done in the form of a concerted programme to monitor the levels of infant mortality and to adopt and implement a campaign to reduce the numbers dying. A study at this time was therefore opportune.

A problem which frequently presents itself to those conducting surveys is the absence of valid and accurate demographic data; and whereas in a large population inaccuracies of the order of 1% or less in either numerator or denominator will make little difference to calculated rates, in small populations they may make a considerable difference. It was essential therefore in this study to obtain the most accurate and valid numerator and denominator figures. It was disappointing to encounter the sometimes gross differences between the SSAFA quarterly returns and the hospital returns (AF W3166); both, theoretically, should include those born in Service hospitals plus those transferred in from Krankenhouses or other locations. To add to the difficulty it was not possible to undertake a validation study at the time although such a study is currently being conducted. Despite this uncertainty, it was felt that the SSAFA figure was the more valid, including as it does infants born in Krankenhouses, MRS's and elsewhere, and to a certain (but as yet unknown) extent, immigrant babies from other commands. It results in an underestimate of rates but this is thought to be small. A change in unit records (Part III orders) to include 'place of birth' might obviate these problems.

Similarly the numbers of babies dying each year, obtained from post-mortem records, differed from the number obtained from the register of deaths. Careful scrutiny of both sources to exclude babies who failed to satisfy the criteria laid down, resulted in the larger figure of the two sources being accepted. Rather disappointingly, as the results indicate, the post-neonatal death rate has risen since 1976. This, in the absence of any apparent change in factors closely associated with infant mortality such as fertility rates, obvious climatic changes, or widespread epidemics of infectious disease. Indeed the commonest cause of death in this series is Sudden Infant Death Syndrome which is at variance with the UK experience (Table V). The reasons for this disparity are thought to be:

- (a) A considerable proportion of children suffering from severe illness or congenital abnormality are returned to UK for care and treatment.
- (b) There is a higher proportion of lower socio-economic group families in BAOR and a high fertility rate.
- (c) A necropsy procedure which is less rigorous than that undertaken by departments specializing in paediatric pathology.

There can be little doubt also that the proportion of deaths attributed to SIDS has risen over the years which may well reflect a growing awareness of the syndrome by pathologists.

There are no great surprises in the epidemiology of the post-neonatal deaths, the findings largely adhering to the pattern of findings in previous studies⁶ with

the exception of the rise in the number of deaths in the summer months. Perhaps a greater awareness of what changes to look for may help pathologists to unravel this mystery.

The problem facing the community physician is how to reduce the death rate. The first question must be to decide what proportion of deaths are preventable? Deaths due to severe congenital abnormality are largely unpreventable, except by the practice of eugenics or termination of pregnancy, so that there is likely to be a lower limit to the incidence of post-neonatal deaths. The solution therefore must lie in preventing deaths due to infection, and to the SIDS. Whether or not SIDS is preventable is a matter for much discussion. Some authorities are quite unequivocal in stating that it is not¹², while others are certain that it is¹³. It has been noted that on careful history taking, a considerable proportion of these 'cot' deaths exhibit symptoms¹³ which, had their significance been appreciated, might have resulted in referral and hence possible prevention of death. Other authors have suggested the use of apnoea or cardiac monitors^{14, 15}.

As demonstrated in the results, and noted by others¹⁶, low birth weight babies are more vulnerable to death in the post-neonatal period. Thus the skill of the obstetrician and neonatal paediatricians in sustaining life in the premature and low birth weight babies has resulted in a larger cohort of vulnerable babies entering the post-neonatal period of life than previously. This in turn might affect the rates of post-neonatal death. Thus it is perhaps better now to view the morbidity and mortality of infants as a continuum extending from conception through birth to their first birthday, rather than separating the periods of their development as is now done, into ante natal, natal, neonatal etc. It may be objected that different problems apply at different times requiring different solutions, but this is no argument for the focusing of research or special medical resources at one particular time of a baby's life only to see it prejudiced through lack of interest or effort at another.

The results indicate that there is a substantial social component to deaths from manifest disease and SIDS, and this social component is likely to be extremely complex. It may be a function of intelligence, of culture, of social distance between GP (uniformed RAMC officer) and mother, or diffidence in the medical services. It is most likely that all of these social factors, and probably more, play a part in the recognition of illness by the mother and her seeking advice. The fault, however, does not lie entirely with the mother; for in approximately 18% of instances, some fault was found on the part of the medical services in the recognition of serious disease or the referral of an ill child to specialist care. This compares favourably with the UK¹¹.

A great deal more of basic health education is required by both patients and health professionals. The patients need to know when their baby is ill and how and when to ask advice. The health visitor and doctor in turn need to know the spectrum of culture and levels of intelligence of their patients so that they can better predict problems, and thus obviate further deterioration or death of the baby.

It was for this very reason, ie. to help distinguish those in greater need of

help, that the scoring system was created. A modified form of the scoring system has been used experimentally in the Munster area by Lt Col Holmes-Smith, Command Adviser in Paediatrics and although the numbers involved are very small, it would not be immodest to claim some success. The system should be adopted on a wider basis in the future, for it is considered to be the best hope in the short term of reducing the post-neonatal death rate in BAOR¹⁷.

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