The 11th Report of the Perinatal and Infant Mortality Committee of Western Australia

2000-01

DEPARTMENT OF HEALTH

Foreword

Chairman's Report

On behalf of the Perinatal and Infant Mortality Committee of Western Australia, I have pleasure in submitting the 11th Report of investigations of deaths in the years 2000-01.

The Committee was re-established in October 2001 to review cases of perinatal and infant deaths for the purpose of examining trends and issues that could lead to improved clinical care. Cases are investigated by one of three appointed investigators, chosen for their skill and expertise. Each case is discussed by the Committee in a de-identified format. An estimate of preventability is made using a previously published scoring system. The deliberations of the Committee are then conveyed by letter to the principal medical practitioner involved in the care of the case. The purpose is educational.

The Report includes details of the Committee's findings for those cases that were investigated, statewide data to place the outcomes in perspective in terms of geography and time, and educational papers on specific topics that emerged as being particularly relevant to healthcare providers in Western Australia.

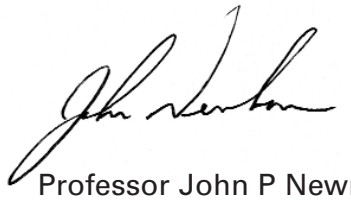
Comparisons with national data indicate that mortality rates for pregnancy and infancy in Western Australia are similar to those in other states, despite the large distances that feature so prominently in our healthcare system. Mortality rates for Aboriginal people remain of great concern and indicate the need for new initiatives in this area.

Improvements in outcomes for pregnancy and infancy cannot arise from advances in technology alone. The finding that aspects of maternal behaviour, such as substance abuse and poor attendance for medical care, may have contributed to nearly one third of the investigated deaths highlights the fact that perinatal and infant mortality rates reflect many features of a society extending beyond the traditional limits of the healthcare system. The Committee has concluded that further improvements in obstetric and infant healthcare would be enhanced by the creation of a statewide integrated service and wishes to lend its support to recent initiatives for such a system.

The Committee wishes to thank the many medical practitioners, midwives and nurses throughout the state who notify the Health Department of cases, and the Committee's investigators who work so tirelessly to assemble the information that enables appropriate evaluations to be made. As Chairman, I would like to express my grateful appreciation to the Committee members who contribute their time and expertise as volunteers, to Dr Catherine Buccilli who took lead role in writing the Report, and to Dr Margaret Stevens, Executive Director, Public Health, who is so supportive of the Committee's role and function.

I trust you will find the Report informative and useful.

Respectfully submitted



Professor John P Newnham
Chair

Table of Contents

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Dr Noel French	Deputy Chair, Neonatal Paediatrician
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Professor Karen Simmer	Neonatal Paediatrician
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Special thanks to:

Ms Vivien Gee, Coordinator, Maternal & Child Health Unit, for her work performed in organisation of this Committee.

Dr Tim Green, Research Officer, Maternal & Child Health Unit, for work performed in statistical analysis for this report.

Adj Assoc Professor Sharon Evans, Biostatistician, for assistance in statistical analysis.

Dr Adrian Charles, Dr Jenni Sokol, Dr Alexis Shub, Dr Jane Freemantle for contributing educational papers for this report.

Assoc Professor Jan Dickinson, Dr Tony Keil, Dr Adrian Charles for contributing to "Guidelines: Appropriate Investigations Following Stillbirth".

1 Executive Summary

1.1 Overview

The Perinatal and Infant Mortality Committee of Western Australia (PN&IMC; "The Committee") is a statutory Committee under the *Health Act 1911*. The Executive Director, Public Health (EDPH) directs an investigator to enquire into perinatal and infant deaths meeting certain criteria; for the years 2000 and 2001 these criteria comprised mainly stillbirths and infant deaths over 32 weeks gestation. The Committee's determination is conveyed in confidence to the medical practitioners involved in these cases. The Committee's role is educational, with the aim of improving health outcomes.

There were 594 perinatal and infant deaths in Western Australia (WA) in the years 2000 and 2001. The Committee reviewed 167 of these and found one or more preventable medical factors in 52 cases (31% of cases investigated). It is expected that the prevalence of preventable factors would be higher in this selected population.

The Committee considered the findings from the investigated cases and reviewed broader perinatal statistics provided by the Health Information Centre of the Department of Health, WA, to formulate the key findings listed in Section 1.2.

The major causes of perinatal mortality are congenital abnormalities, prematurity due to spontaneous preterm births, and "unexplained" antepartum stillbirths. The major cause of post-neonatal mortality is sudden infant death syndrome (SIDS).

There continues to be a gradual reduction in perinatal and infant mortality rates over time, evident from statewide data. Despite this, there remain particular challenges of providing adequate perinatal services to the vast state of WA. In particular, high rates of Aboriginal perinatal and infant mortality continue to be observed. Liaison and consultation with specialists in the management of complications of pregnancy and sick infants is encouraged. Public health initiatives regarding nutrition, folic acid, breastfeeding and safe sleeping practices are promoted. Further, the Committee recommends that consideration be given to the development of a statewide coordinated obstetric service.

Benefits from the work of the Committee as an advisory and educational body may be realised by a review of the relevant provisions of the *Health Act 1911*.

1.2 Key Findings

Comments and Recommendations

Statistics:
In WA in 2000 and 2001 there were 49,795 livebirths; there were 594 perinatal and infant deaths (372 stillbirths, 138 neonatal deaths and 84 post-neonatal deaths).

- The stillbirth rate was 7.4 per 1,000 births.
- The neonatal mortality rate was 2.8 per 1,000 livebirths.
- The post-neonatal mortality rate was 1.7 per 1,000 livebirths.
- The perinatal mortality rate was 10.2 per 1,000 births.
- The infant mortality rate was 4.5 per 1,000 livebirths.
- The preterm birth rate (<37 weeks) was 8.2%.
- The preterm perinatal mortality rate (<37 weeks) was 20.5 deaths per 1,000 births (n=403).
- The perinatal mortality rate was more than two-fold higher in Aboriginal versus non-Aboriginal people.
- The post-neonatal mortality rate was six-fold higher in Aboriginal versus non-Aboriginal infants.

→ *There is a continued downward trend in perinatal and infant mortality rates.*

→ *WA compares favourably with national perinatal and infant mortality rates.*

→ **Recommendation**
Innovative programs are required to address the high rates of Aboriginal mortality.
In particular, culturally appropriate education programs targeting nutrition, diabetes mellitus and alcohol abuse are recommended.

Investigated Deaths:
The Committee investigated 167 of the 594 deaths. (115 stillbirths, 30 neonatal and 22 post-neonatal deaths).

- 52 of 167 (31%) of investigated perinatal and infant deaths in WA 2000-01 had one or more preventable medical factors. 15 of these deaths were considered likely to have been avoidable.

In these 52 cases, outcomes may have been improved by:

- Improved management of obstetric (27 cases) and neonatal conditions (5 cases).
- Earlier referral (11 cases).
- Improved awareness of indications for, and interpretation of, cardiotocographic traces (10 cases).
- Improved technical skills for obstetric delivery (6 cases).
- Improved technical skills for resuscitation of the newborn (6 cases).
- Rapid treatment of neonates with respiratory distress (2 cases).

→ **Recommendation**
An integrated statewide obstetric service may assist delivery of care for the vast state of WA.
This would include:
→ workforce and infrastructure advice and planning
→ producing evidence-based practice protocols, applicable to each area
→ supporting skilled obstetric and paediatric staff in rural areas.

→ **Recommendation**
Early transfer of high-risk patients is advised.

→ **Recommendation**
Transfer services should be valued and adequately resourced.

Frequent liaison with specialists is advised in managing complicated pregnancies and sick infants.

→ **Recommendation**
Healthcare professionals should be supported in the maintenance of necessary knowledge and skills to care for mothers and infants.

1.2 Key Findings

	Comments and Recommendations
Maternal Behaviour: Aspects of maternal behaviour, such as substance use and poor compliance with medical care, may have contributed to 30% of investigated deaths.	→ **Recommendation** Thorough history taking is encouraged, enquiring about smoking, alcohol and drug use. → **Recommendation** Consideration should be given to routine collection of data regarding alcohol and illicit substance use during pregnancy. → **Recommendation** The importance of social risk factors in parenting should be highlighted.
Co-sleeping was associated with 10 of the 52 investigated infant deaths.	→ **Recommendation** Public health programs should continue to educate regarding: → periconceptional folate → compliance with antenatal care → the risks of smoking, alcohol and drug use → the benefits of breastfeeding → safer sleeping practices, with particular attention to risks of co-sleeping. → **Recommendation** All health providers should be encouraged to audit their broader perinatal and infant health outcomes.
Investigations for Cause of Death: 53% of deaths investigated by the Committee had insufficient pathology tests performed to thoroughly assess cause of death.	→ **Recommendation** Thorough investigation into cause of death is recommended. → **Recommendation** Autopsy is highly recommended and is optimally performed in conjunction with paediatric/perinatal pathologists.
Limitations of Perinatal and Infant Mortality Committee: The Perinatal and Infant Mortality Committee is not instructed to review individual cases involving significant morbidity or events other than deaths. The Committee's findings about individual cases may only be conveyed to the attending medical practitioners. The Committee is unable to communicate directly with other health professionals who may have been involved in the cases.	*Consideration should be given to a review of the* Health Act 1911 *governing the Perinatal and Infant Mortality Committee, to enhance its educational activities.*
Data Collection and Coding: There are limitations in interstate comparison of perinatal data due to differences in data collection and reporting methods.	→ **Recommendation** Efforts to create national uniformity in methods of data collection, coding and analyses should be supported in order to improve national perinatal statistics.

2 Introduction

2.1 Background

The public health significance of perinatal and infant mortality surveillance is well recognised throughout the world. Mortality rates are used as epidemiological indicators of the health of nations.[1,2]

In WA, the PN&IMC exists as a statutory Committee under the *Health Act 1911*.[3] The constitution and offices of the Committee are strictly outlined (see Appendix I).

The Committee is required by the *Health Act 1911* to undertake case reviews and determine whether any deaths may have been avoidable. The purpose of the PN&IMC is to identify areas of clinical care which may be improved and to make recommendations to lower perinatal and infant mortality rates. The role of the Committee is educational. The Committee is not a judicial body and operates clearly within the *Health Act 1911*, which states:

"Information, records of interviews, reports, statements, memoranda and other particulars… are not admissible in any court or before any tribunal, board or person in any action, cause or inquiry of any kind whatsoever."

The confidentiality of the information collected by and examined by the Committee is further protected by its status as an approved quality improvement committee under the *Health Services (Quality Improvement) Act 1994*.

2.2 Reporting of Deaths

Midwives are required to report all births (including stillbirths) in WA to the Department of Health via the *Health (Notification by Midwives) Regulations 1994*. In addition, it is a requirement of the *Health Act 1911* that stillbirths, neonatal and infant deaths are notified directly to the EDPH by the attending medical practitioner.

"Whenever any child of more than 20 weeks gestation is stillborn or any child under the age of one year shall die from any cause whatsoever, the fact shall be reported forthwith to the Executive Director, Public Health by the medical practitioner who… certified the cause of the child's death." (Health Act 1911)

To ensure completeness of records, notifications are cross-referenced with records from the Department of Justice, Registry of Birth, Deaths and Marriages.

Statistics regarding all livebirths, stillbirths and infant deaths are regularly published by the Health Information Centre. Relevant publications are *Perinatal, Infant and Maternal Mortality in WA 1996-1998*, published in 2002[4], and the *Perinatal Statistics in WA, 2002: 20th Annual Report of the WA Midwives' Notification System 2002*, published in 2004.[5]

2.3 Reports of the Perinatal and Infant Mortality Committee

The PN&IMC was formed in 1979 and produced regular reports until 1992 (10th Annual Report, analysing deaths in the year 1991).[6] Although the Committee was formally constituted, it was essentially non functional for the years 1992-2000. Further to recommendations in the Douglas King Edward Memorial Hospital Inquiry, the Committee was re-established in October 2001.[7] Retrospective analyses of cases were performed for deaths subsequent to 1st January 2000. The EDPH directed the Committee not to investigate deaths that had occurred prior to 2000.

3 Methods

The Committee formulated recommendations based on detailed investigation of 167 cases that met the criteria for investigation, as well as a review of statistical data provided by the Health Information Centre regarding all 594 stillbirths, neonatal deaths and post-neonatal deaths in 2000 and 2001.

3.1 Definitions

Table 1: Definitions

Stillbirth / Fetal Death:	*Australian Institute of Health and Welfare definition:* Death prior to the complete expulsion or extraction from its mother of a product of conception of 20 or more completed weeks of gestation or of 400g or more birthweight. The death is indicated by the fact that after such separation the fetus does not breathe or show any other evidence of life such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles. (AIHW[8] & PN&IMC[6]) *Australian Bureau of Statistics definition:* A fetus that does not have a heart beat or any sign of life, which is 400g or more in birthweight or, if birthweight is unavailable, greater or equal to 20 weeks in gestation. (ABS[9])
Livebirth:	The complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy which, after such separation, breathes or shows any other evidence of life such as beating of the heart, pulsation of the umbilical cord or definite movement of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached; each product of such a birth is considered liveborn. (WHO[2], AIHW[8])
Stillbirth rate:	The number of fetal deaths per 1,000 total births.
Infant death:	The death of a liveborn infant within the first year of life (prior to the first birthday).
Neonatal death:	The death of a liveborn infant within 28 days of birth.
Post-neonatal death:	The death of a liveborn infant occurring in the remainder of the first year (28-364 days).
Perinatal mortality rate:	The number of fetal and neonatal deaths per 1,000 total births.
Neonatal mortality rate:	The number of deaths of liveborn infants under 28 days of age per 1,000 livebirths.
Post-neonatal mortality rate:	The number of deaths of liveborn infants from 28 days to one year of age per 1,000 livebirths.
Infant mortality rate: (cumulative infant mortality risk)	The number of deaths of infants under one year of age per 1,000 livebirths.
Aboriginal / Indigenous:	A person who identifies themselves as an Aboriginal or Torres Strait Islander, or who is identified as such by the community within which he/she lives.
Aboriginal / Indigenous infant:	Born to a parent who identifies as an Aboriginal or Torres Strait Islander, or is identified as such by a responsible person on admission to hospital.

Note: The World Health Organization (WHO) definition for fetal death is for infants with birthweight greater or equal to 500 g, or 22 weeks gestation where birthweight is unknown.[2]

3.2 Designation of Cases for Investigation by the PN&I Mortality Committee

Of the reported deaths, the EDPH designates those deaths to be further investigated. The *Health Act 1911* states:

"Where the Executive Director of Public Health is satisfied that the cause of death arose from a specific injury, or from an illness that the Committee has directed does not require further investigation, there is no further enquiry into the death".[3]

The EDPH appoints an investigator to enquire into a death and to present a de-identified case summary to the PN&IMC. The Committee considers the circumstances of the case and comments on whether it is felt the death may have been avoidable. The Committee's deliberations are conveyed by letter from the Chairman to the medical practitioners who attended the woman and/or infant.

The criteria set for the investigation of deaths in 2000 and 2001 were:

1. All stillbirths and neonatal deaths greater than 32 weeks gestation, with the exception of those known to be caused by lethal malformations or specific injuries.
2. All post-neonatal deaths due to infection.
3. Other cases, at the discretion of the EDPH.

The Committee held monthly meetings from November 2001 onwards. For those cases selected by the EDPH for investigation, letters were sent to the attending medical practitioners to explain the investigation process and to obtain medical notes regarding cases. The notes were conveyed to the investigators who contacted any other relevant health providers and hospitals for further information. From the available notes, case summaries were prepared using a standard electronic format.

The investigators presented de-identified case summaries to the Committee members, from which the Committee classified each case according to the cause of death and whether the death may have been preventable.

3.3 Preventability Scale

The Committee adopted the use of a "Preventability Scale"[10], obtained from literature published in the Medical Journal of Australia (MJA), to classify potentially avoidable deaths (Table 2). This scale is used to assess aspects of "medical" preventability only. That is, sub-optimal medical or nursing care. It does not reflect aspects of patient lifestyle or poor compliance with health advice which may contribute to poor outcome.

The preventability of an adverse event, as defined by the MJA scale, was assessed as "an error in management due to failure to follow accepted practice at an individual or system level" and accepted practice was taken to be "the current level of expected performance for the average practitioner or system that manages the patient."

Table 2: Preventability Scale

No preventability
1 = virtually no evidence for preventability

Low preventability
2 = Slight-to-modest evidence for preventability
3 = Preventability not likely, less than 50-50 but close call

High preventability
4 = Preventability more likely than not, more than 50-50 but close call
5 = Strong evidence for preventability
6 = Virtually certain evidence for preventability

MJA[10]

3.4 Classification Systems for Aetiology of Death

There is considerable difficulty in interstate and international comparisons of data due to inconsistent classification systems of cause of death. The Committee adopted the new "Perinatal Society of Australia and New Zealand Perinatal Death Classification" (PSANZ-PDC) and the "Perinatal Society of Australia and New Zealand Neonatal Death Classification" (PSANZ-NDC).[11] In addition, the use of these classifications was expanded in this report to describe post-neonatal deaths.

All deaths from January 2000 were retrospectively coded using the PSANZ Classifications (see Appendices II & III). Those deaths that were investigated (n=167) were classified by the Committee at its regular meetings. Those deaths that were not investigated by the Committee (n=427) were classified by both an investigator and a member of the Health Information Centre. The classification of the latter cases is less accurate than for the investigated cases due to limited information available from midwifery notification forms, death certificates, and some autopsy reports. The classification is, however, more comprehensive than previously used systems.

3.5 Maternal Behaviour

The Committee observed that a number of cases had elements of maternal behaviour which may have contributed to poor outcome. To quantify the number of cases involved, an investigator reviewed case notes and classified cases according to whether or not there was documentation suggesting that maternal behaviour may have contributed to the death (Table 3).

Table 3: Maternal Behavioural Factors

1	=	no evidence of adverse maternal behaviour
2	=	maternal behaviour may have had some contribution to poor outcome

3.6 Adequacy of Investigation of Cause of Death

The Committee formulated guidelines for pathology tests to assess cause of stillbirths (see Guideline 6.2).

An investigator reviewed the pathology tests performed for investigated cases and graded them with reference to this guideline and consideration of the circumstances of each case (Table 4).

Table 4: Investigations to Assess Cause of Death

1	=	adequate investigations performed to investigate the cause of death
2	=	some investigations performed, but absence of relevant pathology tests (partially investigated)
3	=	inadequate assessment of cause of death

To be classified as "1", it was deemed necessary to offer autopsy examination. Where autopsy was declined, placental histopathology was considered necessary to adequately investigate the cause of death.

3.7 Autopsy Utility

Those investigated cases that had autopsy examination were reviewed by two practitioners (a perinatal pathologist and an investigator) and classified as to the apparent usefulness of the examination.

The Committee adopted the use of "autopsy utility scale" obtained from literature published in the Journal of the American Medical Association (JAMA)[12]:

Table 5: Autopsy Utility

Categories of Concordance of Clinical and Pathological Diagnoses:

1 = **confirm**
The clinical and pathologic diagnoses were identical or similar enough as to not alter future counselling or recurrence risk.

2 = **change**
The clinical and pathologic diagnoses differed enough to alter future counselling and the recurrence risk, suggesting the autopsy provided clinically relevant information.

3 = **add**
The clinical diagnosis was not altered but additional unexpected findings such as anomalies that required counselling were noted on the perinatal autopsy, thus providing clinically relevant information.

4 = **inconclusive**
The perinatal autopsy demonstrated neither an obvious cause of death nor significant congenital malformations.

JAMA[12]

4 Results

To facilitate greater understanding of the broader picture of perinatal and infant mortality in WA, statewide data are presented here prior to detailing the selected population of cases investigated by the Committee.

4.1 Statewide Data, WA 2000-01:

4.1.1 Births, Perinatal and Infant Mortality Rates

Statistics for livebirths, stillbirths and infant deaths are shown for the cohort 2000 and 2001 in Table 6.

- In the two-year period there were 49,795 livebirths, 372 stillbirths, 138 neonatal deaths and 84 post-neonatal deaths. The Committee investigated 115 stillbirths, 30 neonatal and 22 post-neonatal deaths. One stillbirth was less than 400 g weight.
- 3.3% of livebirths and 8.6% of stillbirths were from multiple pregnancies.
- The stillbirth rate was 7.4 per 1,000 births (for birthweight ≥400 g and/or over 20 weeks gestation). The neonatal mortality rate was 2.8 per 1,000 livebirths. Together, these give the perinatal mortality rate of 10.2 per 1,000 births (for birthweight ≥400 g and/or over 20 weeks gestation).
- The infant mortality rate was 4.5 per 1,000 livebirths.
- The preterm (<37 wks) birth rate was 8.2%. The preterm perinatal mortality rate was 20.5 deaths per 1,000 births.
- 80.1% of stillbirths and 76.1% of neonatal deaths occurred in preterm (<37 wks) deliveries.
- Very low birth weight babies (<1000 g) represented 61% of the stillbirths and 35% of the infant deaths.
- The perinatal mortality rate for infants ≥1500 g birthweight was 3.6 per 1000 births, and that for infants ≥2500 g was 2.4 per 1000 births.

Table 6: Perinatal and Infant Mortality by Birthweight, WA 2000-01

Infant Weight / g	Total Births	Livebirths	Stillbirths		Neonatal Deaths		Perinatal Deaths†		Post-Neonatal Deaths		Infant Deaths‡	
	N	N	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
<500	180	29	151	838.9	26	896.6	177	983.3	1	34.5	27	931.0
500-749	144	95	49	340.3	37	389.5	86	597.2	4	42.1	41	431.6
750-999	124	97	27	217.7	8	82.5	35	282.3	2	20.6	10	103.1
1000-1499	332	310	22	66.3	11	35.5	33	99.4	6	19.4	17	54.8
1500-1999	632	617	15	23.7	11	17.8	26	41.1	3	4.9	14	22.7
2000-2499	2095	2067	28	13.4	12	5.8	40	19.1	15	7.3	27	13.1
2500-2999	7927	7897	30	3.8	10	1.3	40	5.0	22	2.8	32	4.1
3000-3499	18131	18106	25	1.4	11	0.6	36	2.0	15	0.8	26	1.4
3500-3999	15085	15069	16	1.1	8	0.5	24	1.6	12	0.8	20	1.3
4000-4499	4743	4737	6	1.3	1	0.2	7	1.5	3	0.6	4	0.8
≥4500	767	766	1	1.3	2	2.6	3	3.9	1	1.3	3	3.9
Unclassified	7	5	2	N/A	1	N/A	3	N/A	0	0.0	1	N/A
TOTAL	50167	49795	372	7.4	138	2.8	510	10.2	84	1.7	222	4.5

† Perinatal Mortality Rate = $\frac{\text{Number of stillbirths + neonatal deaths in the cohort}}{\text{Number of stillbirths + livebirths in the cohort}}$ x 1000

‡ Infant Mortality Rate = $\frac{\text{Number of neonatal deaths + post-neonatal deaths in the cohort}}{\text{Number of livebirths in the cohort}}$ x 1000

Table 7: Perinatal & Infant Mortality by Gestational Age, WA 2000-01

Gestational Age (weeks)	Total Births N	Livebirths N	Stillbirths N	Stillbirths Rate	Neonatal Deaths N	Neonatal Deaths Rate	Perinatal Deaths N	Perinatal Deaths Rate	Post-Neonatal Deaths N	Post-Neonatal Deaths Rate	Infant Deaths N	Infant Deaths Rate
≥20	50167	49795	372	7.4	138	2.8	510	10.2	84	1.7	222	4.5
≥22	50040	49781	259	5.2	124	2.5	383	7.7	84	1.7	208	4.2
27-28 (inc.)	133	115	18	135.3	4	34.8	22	165.4	5	43.5	9	78.3
29-30 (inc.)	200	179	21	105.0	6	33.5	27	135.0	2	11.2	8	44.7
31-32 (inc.)	354	342	12	33.9	5	14.6	17	48.0	3	8.8	8	23.4
33-42 (inc.)	49089	48975	114	2.3	54	1.1	168	3.4	68	1.4	122	2.5
>42	16	15	1	62.5	–	–	1	62.5	–	–	–	–
<37	4151	3853	298	71.8	105	27.3	403	97.1	29	7.5	134	34.8
32-37 (inc.)	6744	6687	57	8.5	28	4.2	85	12.6	29	4.3	57	8.5

4.1.2 Causes of Death

Figures 1a,b,c show the causes of death for the 594 perinatal and infant deaths by PSANZ codings.

Figure 1a illustrates the causes of perinatal death by PSANZ-PDC and infant deaths by PSANZ-NDC. The leading causes of perinatal deaths were congenital abnormality (26%) and prematurity due to spontaneous delivery (17%), with 16% classified as "unexplained" antepartum deaths. The leading causes of infant deaths by PSANZ-NDC were SIDS/other (24%), congenital abnormalities (23%) and extreme prematurity (19%).

Figure 1a: Perinatal and Infant Deaths by PSANZ Classifications, WA 2000-01

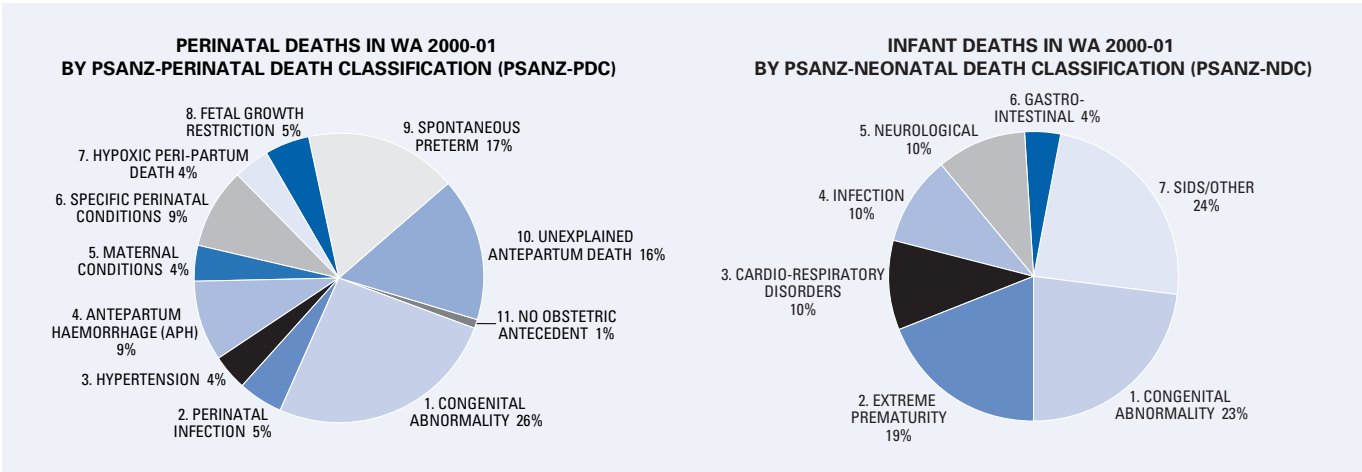


Figure 1b shows causes of perinatal deaths by PSANZ-PDC, divided into the two groups: "stillbirth" and "neonatal". The leading categories of stillbirth by PSANZ-PDC were congenital abnormality (26%), unexplained (22%) and spontaneous preterm delivery (11%). The leading causes of neonatal death by PSANZ-PDC were prematurity due to spontaneous preterm delivery (37%) and congenital abnormality (28%).

Figure 1b: Perinatal Deaths: Stillbirths and Neonatal Deaths by PSANZ-PDC, WA 2000-01

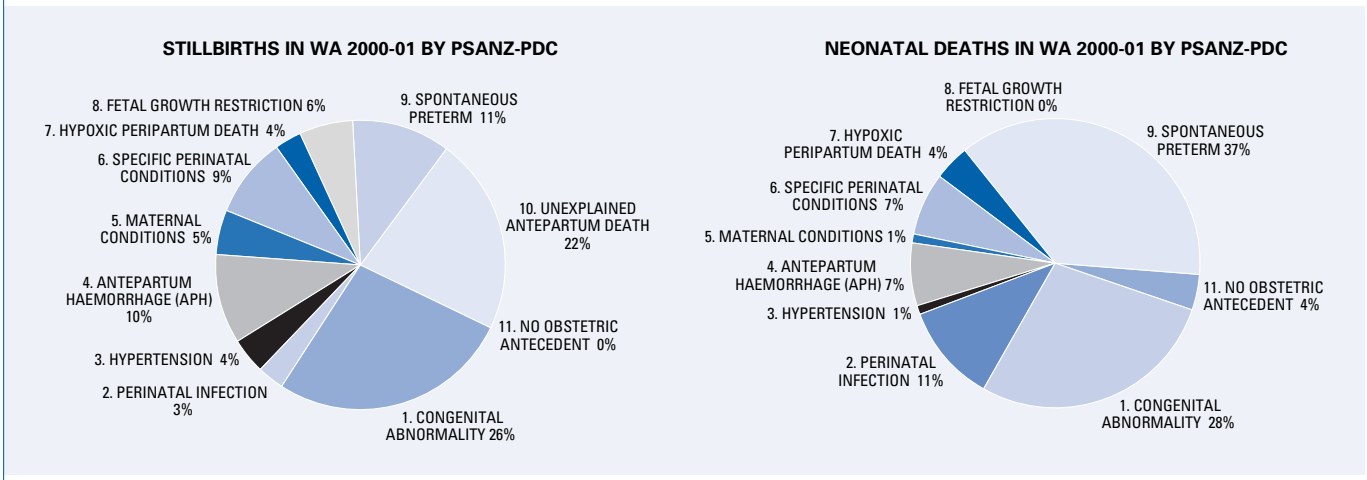
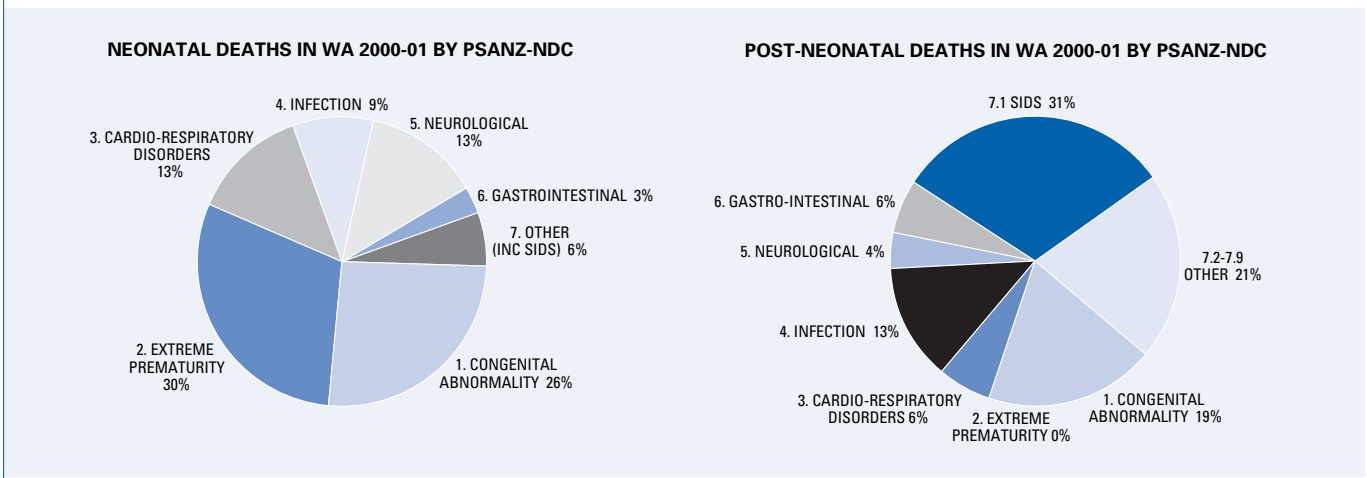


Figure 1c illustrates the differences in causes of infant deaths in the neonatal versus post-neonatal period, according to PSANZ-NDC. The leading causes of death in the neonatal period were extreme prematurity (30%) and congenital abnormalities (26%), which differ from the leading categories of death in the post-neonatal period of SIDS (31%), "other/undetermined" (21%) and congenital abnormalities (19%).

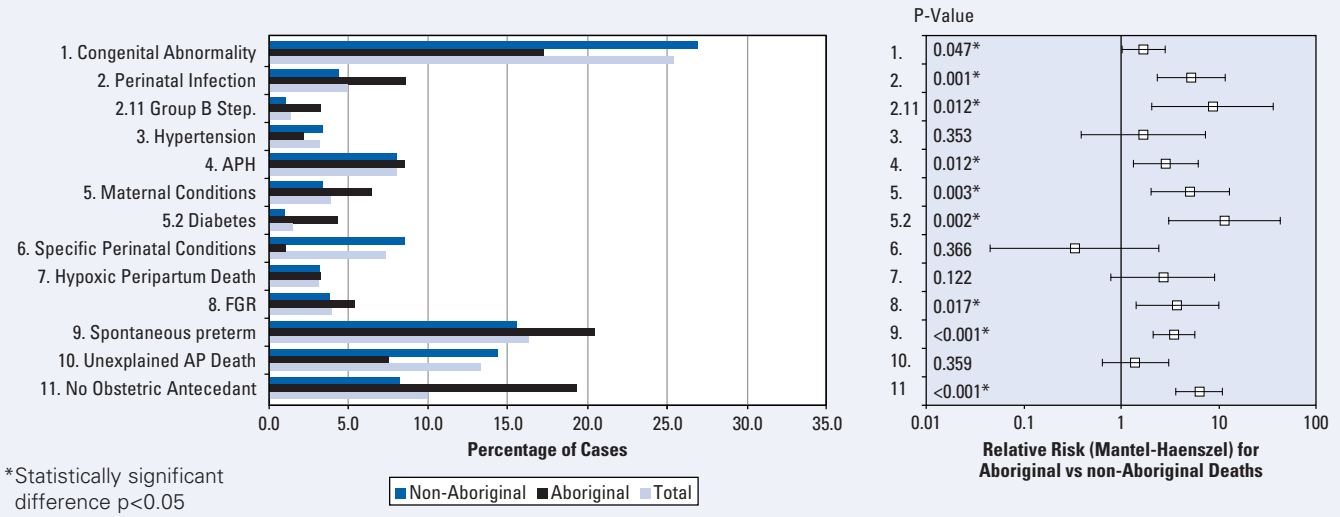
Figure 1c: Infant Deaths: Neonatal and Post-neonatal Deaths by PSANZ-NDC, WA 2000-01



4.1.3 Causes of Death by Maternal Race

Compared to the non-Aboriginal population, the Aboriginal population experienced significantly more perinatal deaths related to maternal diabetes (p=0.002), infection (p=0.001), antepartum haemorrhage (p=0.012), fetal growth restriction (p=0.017) and prematurity due to spontaneous preterm delivery (p<0.001). There were also significantly more Aboriginal neonatal deaths with no antecedent obstetric problem (p<0.001) (Figure 2).

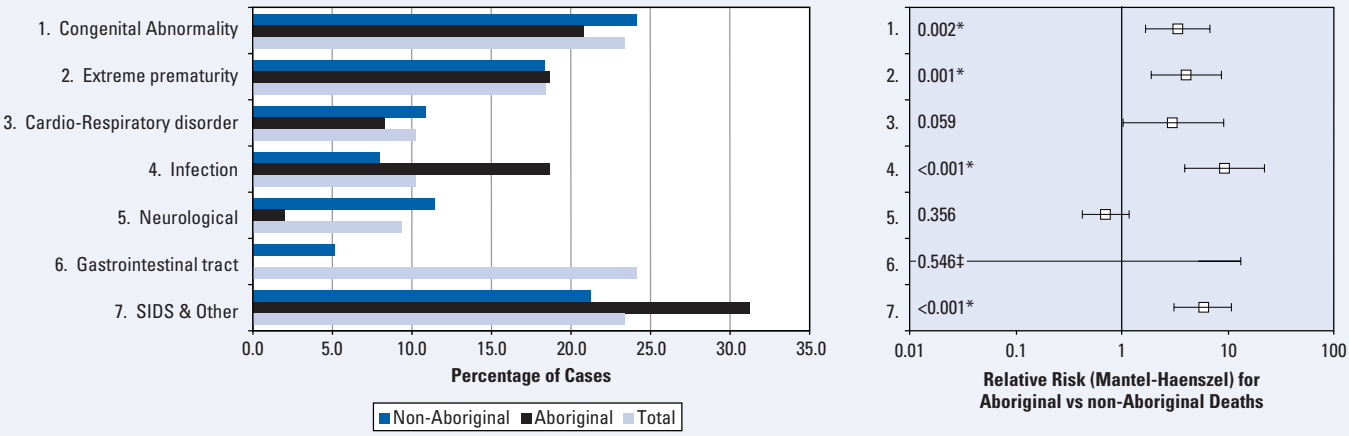
Figure 2: Perinatal Deaths by PSANZ-PDC and Race, with Relative Risk Ratios, WA 2000-01



*Statistically significant difference p<0.05

Aboriginal infants had significantly increased risk of death due to infection (p<0.001), congenital abnormalities (p=0.002), extreme prematurity (p=0.001) and SIDS/other (p<0.001) compared with non-Aboriginal infants (Figure 3).

Figure 3: Infant Deaths by PSANZ-NDC and Race, with Relative Risk Ratios, WA 2000-01



*Statistically significant difference p<0.05 ‡No Aboriginal cases were classified in this category.

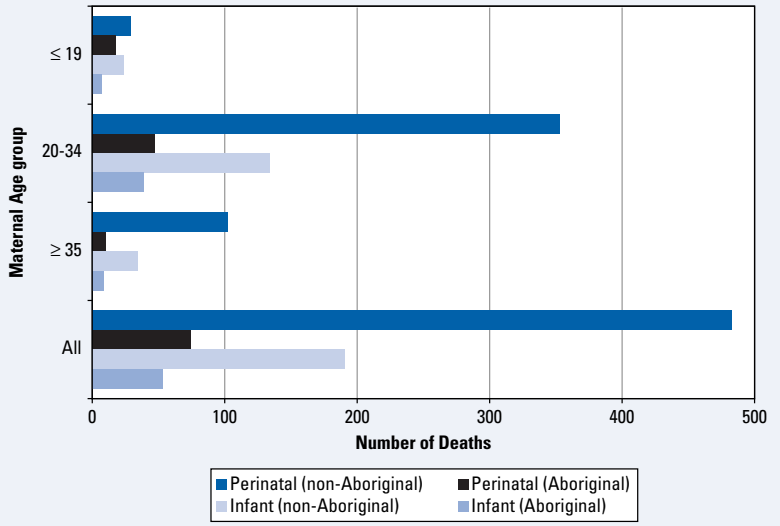
4.1.4 Mortality Rates by Maternal Age and Race

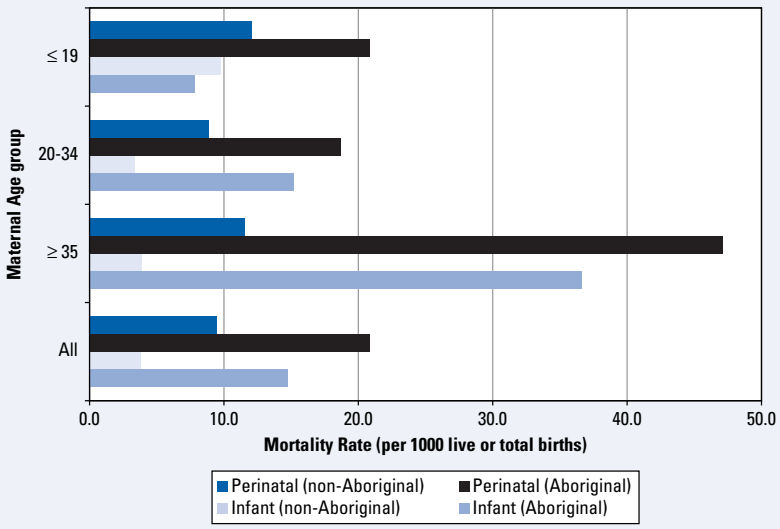
Table 8 and Figure 4 show mortality rates by age and ethnic grouping. Overall Aboriginal mortality rates were greater than non-Aboriginal mortality rates, with the most significant differences being in the post-neonatal mortality rates for Aboriginal infants (7.8 per 1000 livebirths) versus non-Aboriginal (1.3 per 1000 livebirths). The mortality rates for infants of mothers under 20 years of age were similar for Aboriginal and non-Aboriginal populations, but the overall numbers were low.

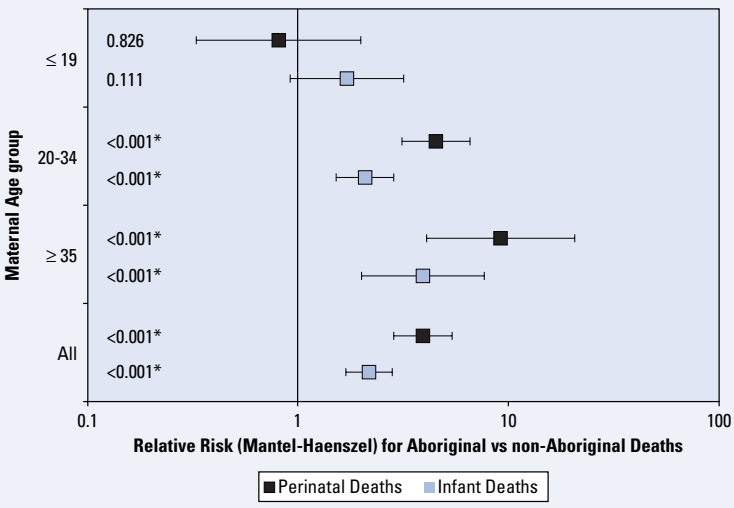
Table 8: Stillbirth, Neonatal and Post-neonatal Mortality Rates by Maternal Age and Race, WA 2000-01

	Stillbirths				Neonatal Deaths				Post-neonatal Deaths			
	non-Aboriginal		Aboriginal		non-Aboriginal		Aboriginal		non-Aboriginal		Aboriginal	
Maternal Age	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**	**N**	**Rate**
≤19	15	7.0	13	16.9	11	5.1	3	4.0	10	4.7	3	4.0
20-34	243	6.6	30	13.0	80	2.2	13	5.7	42	1.2	22	9.7
≥35	69	8.6	2	10.5	24	3.0	7	37.0	7	0.9	0	0.0
All	327	7.0	45	13.8	115	2.5	23	7.1	59	1.3	25	7.8

Figure 4: Perinatal and Infant Mortality Rates by Maternal Age and Race, WA 2000-01



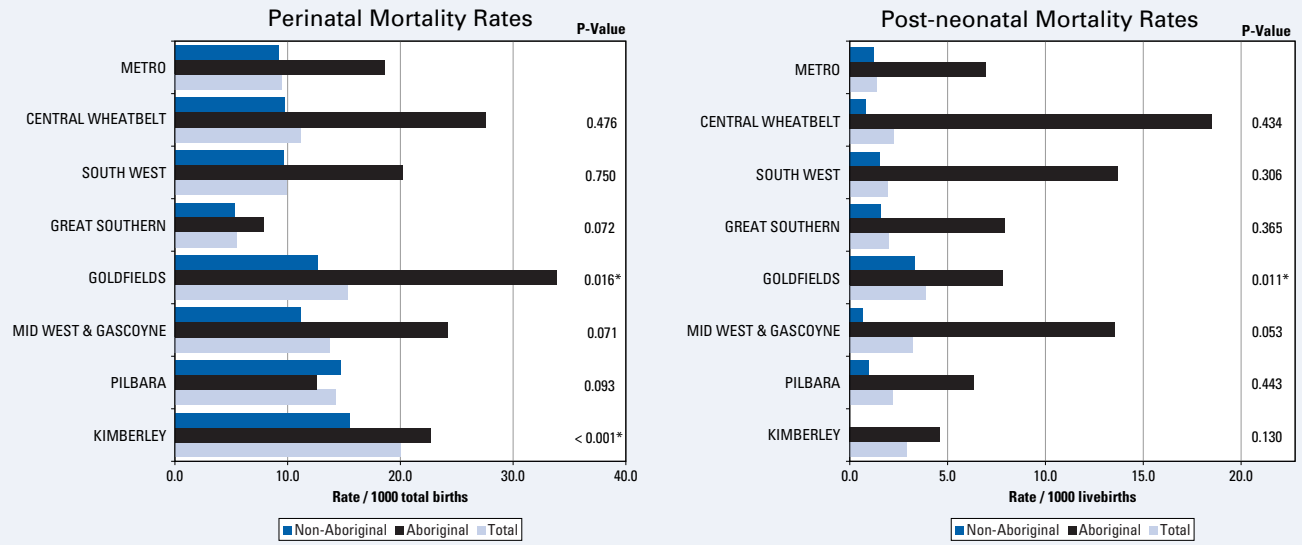




*Statistically significant difference p<0.05

4.1.5 Mortality Rates by Maternal Residence

Figure 5: Perinatal and Post-neonatal Mortality Rates by Region, WA 2000-01



The "p" values apply to differences in mortality rates in metropolitan versus each rural area, for the total population.
*Statistically significant difference p<0.05

Figure 5 shows significant differences in mortality rates for different geographic locations within Western Australia. These figures are derived using maternal postcodes for residence, and do not always reflect where births occurred.

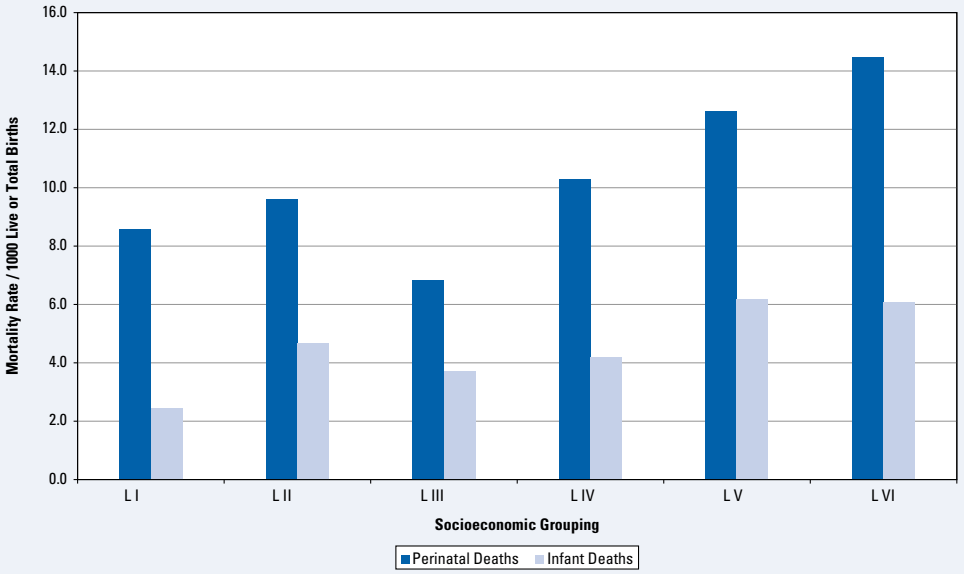
Overall perinatal and post-neonatal mortality rates were generally higher in the northern compared with the southern parts of the state. Perinatal mortality rates for the Goldfields and Kimberley regions were significantly higher than the metropolitan area. They were also higher in the Mid-West/ Gascoyne and Pilbara areas, though the differences in these rates did not reach statistical significance. Post-neonatal mortality rates were significantly higher in the Goldfields compared with the metropolitan area.

Differential racial mortality rates are illustrated, being higher in Aboriginal people in metropolitan and rural areas.

4.1.6 Mortality Rates and Socioeconomic Factors

Figure 6 shows further assessment of the association between socioeconomic status and perinatal and post-neonatal mortality, using maternal postcode as a marker for socioeconomic status. The SEIFA Disadvantage Index published by the Australian Bureau of Statistics (ABS)[9] for each 2001 Census Collection District in WA was used to allocate each postcode to a Socioeconomic Level. The postcodes are grouped so that Level I represents "least disadvantage" and Level VI represents "greatest disadvantage" (0.4% cases unclassified).

Figure 6: Perinatal and Infant Mortality and Socioeconomic Status, WA 2000-01

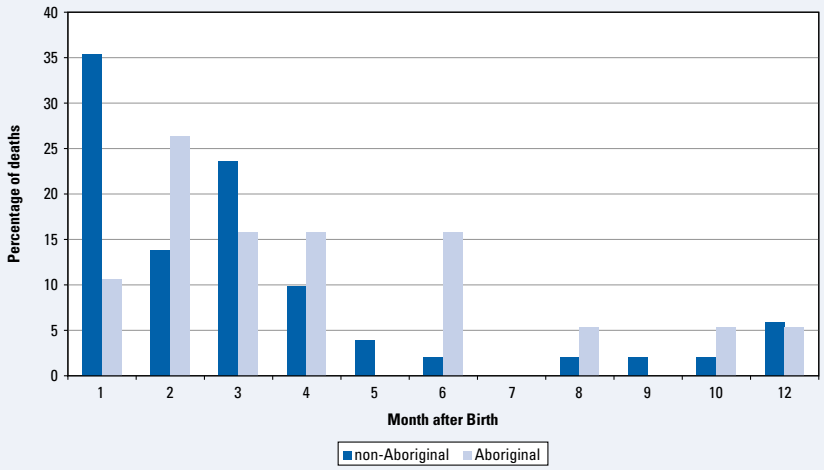


ABS[9]

4.1.7 Infant deaths: Age distribution

Figure 7 shows the distribution of infant deaths by age, illustrating the preponderance of deaths in the earlier months of infancy.

Figure 7: Infant Deaths by Age and Race, WA 2000-01

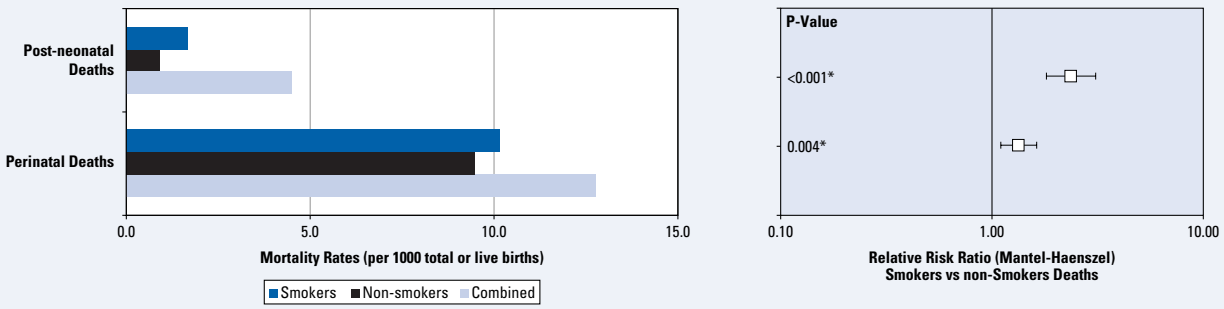


4.1.8 Mortality Rates and Smoking Status

Data were collected regarding maternal smoking in 592 of 594 cases; 30.8% of mothers smoked.

Figure 8 shows significantly increased perinatal and post-neonatal mortality rates associated with maternal smoking. Infants of smoking mothers were at quadruple the risk of post-neonatal death compared with infants of non-smokers.

Figure 8: Maternal Smoking and Perinatal and Post-neonatal Deaths, WA 2000-01



*Statistically significant difference p<0.05

4.1.9 Autopsy Rates

Autopsy examinations were performed in 335 of the 594 deaths (56.4%). Autopsies were performed in 60.2% of stillbirths, 42.0% of neonatal deaths and 63.1% of post-neonatal deaths.

4.2 Cases Investigated by the Committee

The EDPH directed investigation of all stillbirths and neonatal deaths greater than 32 weeks gestation (with the exception of those known to be caused by lethal malformations or specific injuries), all post-neonatal deaths due to infection, and other cases of interest. In accordance with these criteria, the Committee investigated 167 cases: 115 of the 372 stillbirths, 30 of the 138 neonatal deaths and 22 of the 84 post-neonatal deaths in WA in 2000 and 2001. The vast majority of the investigated cases (106 stillbirths, 28 neonatal deaths and 20 post-neonatal deaths) were in infants ≥33 weeks gestational age (five cases less than 33 weeks gestation).

Cases were coded by PSANZ mortality codes.

Of the 115 investigated stillbirths, 44 were unexplained. There were between 8 and 11 cases in each of the categories of fetal growth restriction, antepartum haemorrhage, hypoxic peripartum death, maternal conditions (including diabetes mellitus), hypertension, specific perinatal conditions and infection. None of the investigated stillbirth cases were identified as having congenital abnormalities.

There were 30 neonatal deaths investigated. Five involved congenital abnormalities, six infection, 13 neurological problems, and six other causes of death. Two of the 30 cases had no antecedent obstetric problem.

Thirteen of the 22 investigated post-neonatal deaths had no antecedent obstetric problem. Ten died from "other" causes (including SIDS), six from infection, three from congenital abnormalities, and one in each of the categories of chronic lung, neurological and gastro-enterological diseases.

4.2.1 Deaths with Medically Preventable Factors

The Committee reviewed the cases and assessed whether any aspects of medical or nursing care could have contributed to poor outcomes. A six point "medical preventability score" was used to describe each case, with 1 = virtually no evidence for preventability and 6 = virtually certain evidence for preventability. This scale was applied to assess medical management and does not reflect aspects of patient behaviour which may have contributed to poor outcome.

Table 9: Preventability Scores of Investigated Cases, WA 2000-01

Preventability Score	Stillbirths	Neonatal Deaths	Post-Neonatal Deaths	Total
1	83	10	22	115
2	17	9	0	26
3	8	3	0	11
4	4	5	0	9
5	2	1	0	3
6	1	2	0	3
Total	115	30	22	167

Of the 167 cases investigated, the Committee coded 52 as having any (even slight-to-modest) evidence of preventability (preventability score ≥2), and 15 that were likely to have been avoidable (preventability score ≥4) (Table 9). Table 10 gives a break-down of reasons for preventability scores ≥2, categorised broadly as "medical care" or "systems" issues. Cases may have had more than one "preventable" factor.

Table 10: Medical Management Issues Possibly Contributing to Deaths, WA 2000-01

	Number of cases
Medical care	
management of obstetric conditions (other than technical skills)	27
management of neonatal conditions (other than resuscitation skills)	5
insufficient consultation/referral to specialist care	11
technical skills in obstetric delivery	6
technical skills for resuscitation of newborn	6
continuous electronic fetal heart rate monitoring indicated but not performed	7
interpretation of fetal heart rate traces	3
Systems issues	
assessment or treatment delays	2
staffing issues	8

Of the 52 cases with preventability scores ≥2 aspects of medical care were pertinent to 50 cases:

- 8 cases (15.7%) involved maternal hypertension in pregnancy.
- 6 cases (11.8%) involved maternal diabetes in pregnancy. One case involved a non-English speaking patient with significant compliance problems. No interpreter had been used in the consultations.
- 6 cases (11.8%) involved technically difficult obstetric deliveries.
- 6 cases (11.8%) where medical and/or midwifery staff had difficulty in resuscitation of the newborn.
- 2 cases involved delays in the recognition and treatment of respiratory distress in a neonate.

- 11 cases (21.6%) where consultation or referral to specialist care may have improved outcome. Of these, 5 were rural cases and 1 involved a home-birth.
- Absence of continuous fetal heart rate monitoring when indicated (7 cases) and mis-interpretation of fetal heart rate traces (3 cases) may have affected outcome in 19.6% (10 cases).

In addition, "systems issues" such as delays in treatment and staffing problems contributed to nearly one fifth of the cases with preventability scores ≥2.

Cases in which there were delays in transfer of patients due to transport difficulties were not classified as "preventable" on the basis of these delays. Many cases involved transfer of patients and two particular cases with poor outcomes were significantly affected by unavoidable delays in Royal Flying Doctor Service (RFDS) transfers. These were not coded as "preventable" as the delays were outside the control of the managing medical staff.

There was no documentation to suggest that any cases were affected by equipment problems.

Table 11 gives examples of cases with preventability scores ≥4.

Table 11: Cases With Preventability Scores ≥4, WA 2000-01

Delays in assessment after antepartum haemorrhage
Inappropriate use of syntocinon infusions leading to uterine rupture
Inadequate monitoring following motor vehicle accident
Prostaglandin induction for pre-eclampsia without electronic fetal heart rate monitoring in labour
Presentation with reduced fetal movements, without adequate evaluation of fetal well-being
Ineffective resuscitation of newborn with bag and mask ventilation
Embarking on technically difficult operative deliveries without readily available specialised expertise

4.2.2 Intrapartum Stillbirths

There were 21 term (≥37 weeks) intrapartum deaths investigated by the Committee. (There were 24 term intrapartum stillbirths in the statewide data for 2000 and 2001).

Of these investigated cases, three were thought to have been avoidable (preventability score ≥4) and 11 to have some evidence for preventability (preventability score ≥2). The Committee considered that seven of these cases may have had better outcomes with improved application and interpretation of electronic fetal heart rate monitoring.

4.2.3 Home Births

There were three deaths (two stillbirths and one neonatal death) in planned homebirths. These were scored for medically preventable factors (preventability scores 3, 3 and 2). In addition, maternal behavioural factors may have contributed to the poor outcome of two of these cases.

4.2.4 Maternal Behaviour and Lifestyle Factors

Medical notes of the 167 investigated cases were reviewed to identify aspects of maternal behaviour which may have contributed to deaths (see section 3.5).

Smoking prevalence in the investigated cases (31.1%) was similar to the prevalence of maternal smoking recorded by the state data for perinatal and infant deaths in WA in the years 2000 and 2001 (30.8%). Of the investigated stillbirths, 28% of mothers smoked, compared with 26% in state data. Of the investigated neonatal deaths 23% of mothers smoked, compared with 29% in state data, and 59% of mothers were smokers in the investigated post-neonatal deaths compared with 56% of mothers in the statewide data for post-neonatal deaths.

Alcohol abuse was included only where the notes recorded excessive alcohol consumption. There was documentation of the presence or absence of maternal alcohol use in 52% of investigated cases.

There were 51 cases identified where maternal behaviour (other than smoking) may have contributed to the poor outcome (Table 12).

Coincidentally a similar number of cases were graded with preventable medical factors as were those with possibly contributory maternal factors. These two groups overlap.

The documentation suggested that most of these 51 women lived in difficult social situations. Examples of the types of circumstances where maternal (or social) factors were thought to contribute to fetal or infant death include:

- 15 year old, with little antenatal care, refusing examinations
- Heavy alcohol abuse in pregnancy, with maternal Mallory-Weiss tear
- Infant death with autopsy findings suggestive of a shaking injury
- Infant found near open fire, co-sleeping with excessive blankets

Of the ten infant deaths related to co-sleeping, nine involved Aboriginal families. One case involved "overlaying" of the infant by an intoxicated mother. The Coronial report in this case stated that there was documented "positive" alcohol in the infant's blood, but this was not quantified. The report stated that this blood alcohol was thought to be related to breast feeding. The other cases of deaths related to co-sleeping had no documentation as to whether alcohol and/or drug use were associated. Four of the cases involved co-sleeping with the mother only; four involved co-sleeping with the mother and father or other siblings, and two did not specify whether there were other people co-sleeping apart from the mother.

Table 12: Maternal Behaviour Possibly Contributing to Deaths, WA 2000-01

	Number of Cases
Alcohol abuse	14
Illicit drug abuse	14
Poor compliance with medical care	21
Co-sleeping	10
Domestic violence	3

4.2.5 Pathology Investigations into Cause of Death

The cases were assessed to determine the adequacy of investigations performed to identify the cause of death. Of the 167 cases investigated, 78 were considered adequately investigated, 57 cases were partially investigated and 32 cases had very little or no investigation into the cause of death. In all, 53% of deaths had insufficient pathology investigations performed to thoroughly determine the cause of death.

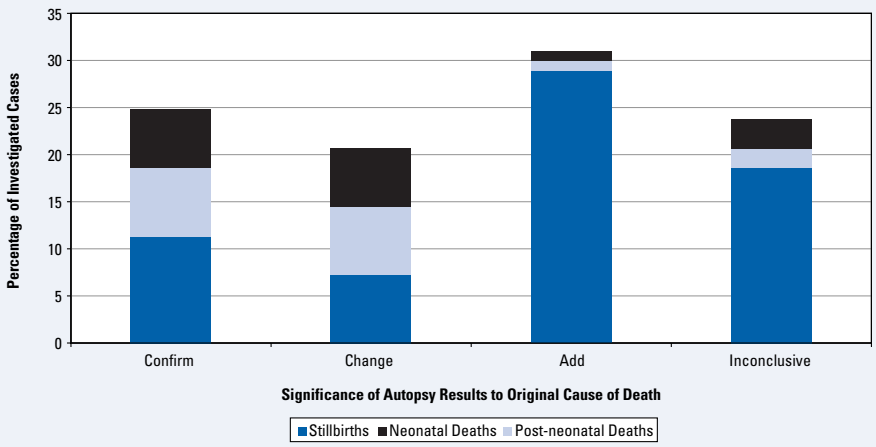
Of the investigated stillbirths (n=115), 14.8% had a Kleihauer-Betke test performed; 20.9% had cultures taken (including any maternal, placental and/or infant bacterial swabs) and 31.3% had an autopsy examination. Of those stillbirths that were coded as "unexplained antepartum" (n=25), 20% had a Kleihauer-Betke test, 48% had cultures taken and 60% had an autopsy.

4.2.6 Autopsy Utility

Of the 167 investigated deaths, 98 (58.7%) had an autopsy performed.

Of those cases assessed by autopsy, in 25% the autopsy confirmed the clinical diagnosis, in 21% the autopsy findings changed the diagnosis, in 31% they added some extra information and in 23% they were inconclusive (Figure 9).

Figure 9: Autopsy Utility for Perinatal & Infant Deaths, WA 2000-01



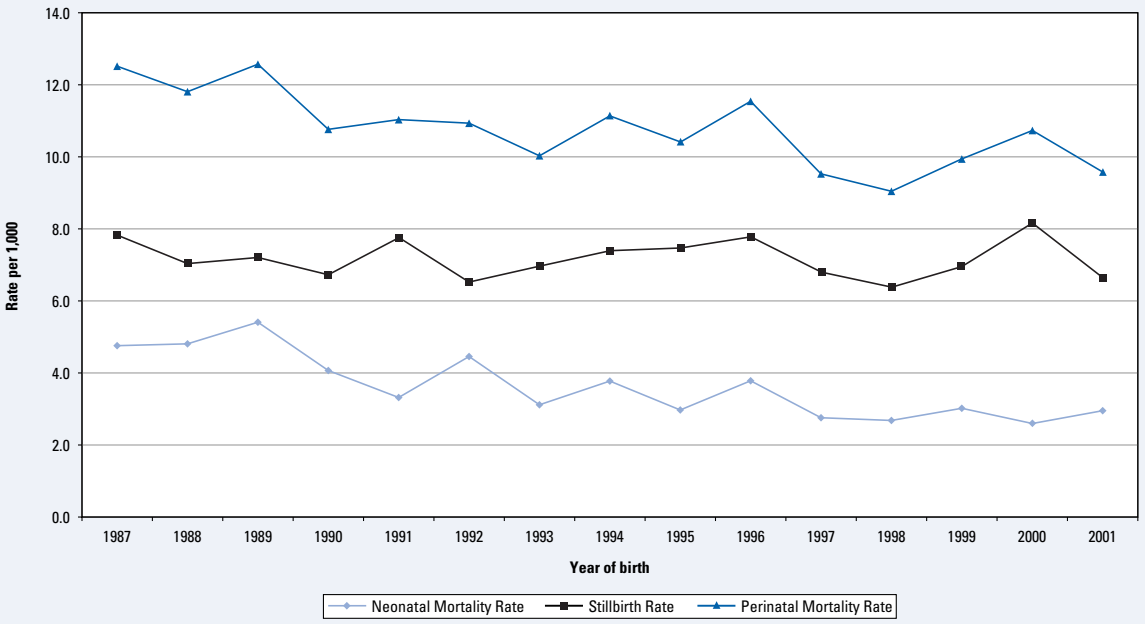
5 Commentary

5.1 Trends in Perinatal Mortality in WA and Nationally

Perinatal mortality rates in Australia have fallen from 22.3 per 1,000 births in 1973 to 8.4 per 1,000 births in 2001, according to ABS data. There has been a greater decline in the neonatal mortality rate than the stillbirth rate. Over the period 1980-2000, the neonatal mortality rate declined by 53%; from 6.6 per 1,000 live births to 3.1 per 1,000 live births.[9,13,14]

Figure 10 illustrates the gradual decline in perinatal mortality rates in WA from 1987-2001, using data from the Department of Health, WA.[4,5] This reduction is primarily due to a reduction in the neonatal mortality rate.

Figure 10: Perinatal Mortality Rates WA 1987-2001



Gee V [4,5]

Comparison with other states and countries is difficult due to differences in methods of data collection and reporting of rates. The ABS data are obtained from deaths registered by the State and Territory Registrars-General during the calendar year. The death statistics are based on year of registration of the death (not of the birth) and there may be delays in registration of deaths. It is recognised that perinatal deaths may be underestimated.[13]

WA data are based on linking the data for the cohort year of birth (not death). Data are obtained from midwifery notification forms, the Registrar General's office, and from notifications made to the EDPH, resulting in a more complete database than that of the ABS, with recorded numbers of deaths being higher than ABS figures.

The Australian Institute of Health and Welfare's National Perinatal Statistics Unit (NPSU) produces annual "Mothers and Babies" reports, utilising the "perinatal minimum data set" collected by the State and Territory Health Departments. These national "perinatal minimum data set" guidelines have been revised on several occasions since being introduced in 1979. The current recommended guidelines are set out by the National Perinatal Data Development Committee (NPDDC)[15], and are defined in the National Health Data Dictionary (NHDD).[16]

The NPSU reports analyse more comprehensive data than those obtained by the ABS. Unfortunately the perinatal mortality data from all state and territory perinatal collections are still incomplete and the only consistent national data regarding perinatal deaths are from the ABS.[8,9] Efforts are being made by the NPSU to enhance national perinatal health data systems.[15]

ABS interstate and territory comparisons of perinatal mortality rates show that WA compares favourably with other states (Table 13).[9]

Table 13: Perinatal Mortality Rates by State, 1991-2001

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUST
1991	11.0	9.8	11.1	9.0	10.3	11.9	18.2	12.5	10.6
1997	9.8	8.5	9.1	8.2	8.1	11.6	15.5	6.6	9.2
1998	8.1	7.7	9.6	7.2	7.5	9.8	13.1	12.2	8.3
1999	8.1	9.2	8.2	6.6	8.3	10.7	16.1	11.7	8.5
2000	7.7	7.9	8.9	8.2	8.4	10.6	14.5	8.3	8.3
2001	7.8	8.7	9.7	8.5	7.9	5.6	12.2	8.3	8.4

ABS[9]

For comparison, data from the United Kingdom (UK) and United States (USA) are presented in Table 14. The UK data are collected by the Confidential Enquiry into Stillbirths and Deaths (CESDI).[17] Combining the stillbirth and neonatal rates gives an approximate perinatal mortality rate in the UK of 8.9 per 1,000 births*, which is similar to the Australian ABS figure of 8.5 and to the WA ABS figure of 8.3 per 1,000 births in 1999.[9,14]

The data from USA use different criteria again, defining neonatal deaths as deaths in the first week of life.[18] Despite this inconsistency, these figures are not dissimilar to Australian rates. There are well recognised difficulties in international comparisons of perinatal mortality rates due to differences in criteria for registration and publication.[19]

Table 14: Perinatal Mortality Data UK and USA

UK Perinatal and Infant Mortality Rates in 1999:

Stillbirth rate:	5.0 per 1,000 total births
Neonatal mortality rate:	3.9 per 1,000 livebirths
Post-neonatal mortality rate:	1.8 per 1,000 livebirths
Combined stillbirth, neonatal and post-neonatal death rate:	11.1 per 1,000 total births.

8th Annual CESDI Report[17]

USA Perinatal mortality rates, 1980 and 1998:

	Overall rate	Caucasian mother	Black mother
1980	13.2	11.9	21.3
1998	7.2	6.2	13.1

Vital Statistics of the United States[18] using criterion of gestational age ≥20 weeks per 1,000 livebirths and infant deaths up to 7 days of age

*There is a minor difference in criteria. Australian perinatal mortality rates are calculated using stillbirths plus neonatal deaths per 1000 total births. The UK perinatal mortality rate calculated here is based on stillbirths per 1000 total births, plus neonatal deaths per 1000 livebirths.

5.2 Causes of Perinatal Mortality

The ABS has, since 1997, used the International Classification of Diseases (ICD-10)[20] to code cause of death from death certificates. In 2001 the ABS found that 43% of fetal deaths were not allocated to a specific cause of death, 19% were recorded as intra-uterine hypoxia, 13% congenital malformations and 10% disorders related to length of gestation and fetal growth. A maternal medical condition was reported in 68% of cases of perinatal deaths.[9]

Using the PSANZ coding system, 22% of stillbirth in WA in 2000-01 were "unexplained", 26% due to congenital abnormalities and 11% related to spontaneous preterm delivery. These are similar rates to those of South Australia (SA) in 2001, using the PSANZ classification which recorded 28 of 120 (23%) stillbirths as "unexplained antepartum". Similar figures were found for a collaborative study of data from three states (Queensland, Victoria and SA) for the year 2000, where 29.5% of stillbirths were categorised as "unexplained antepartum deaths".[21] These figures illustrate that the ABS data give a significantly higher proportion of "unexplained" fetal deaths (43%) compared with these states' perinatal data (29.5%), due to differences in collection techniques and interpretation methods.

ICD-10 codings are useful for international comparisons, but the PSANZ categorisations give more detailed information which may be useful in guiding public health initiatives to improve perinatal outcomes. Ideally there would be conformity in data collection and classification. In this respect, the PSANZ advocate adoption of PSANZ classification systems to be used nationally.[11] The Committee is supportive of the proposal that PSANZ classifications of stillbirths and neonatal deaths be added to the national minimum data set.

Whilst the PSANZ-PDC and PSANZ-NDC systems were designed only for the classification of stillbirths and neonatal deaths, the Committee expanded their use to code for post-neonatal deaths in this report.

Recommendation:

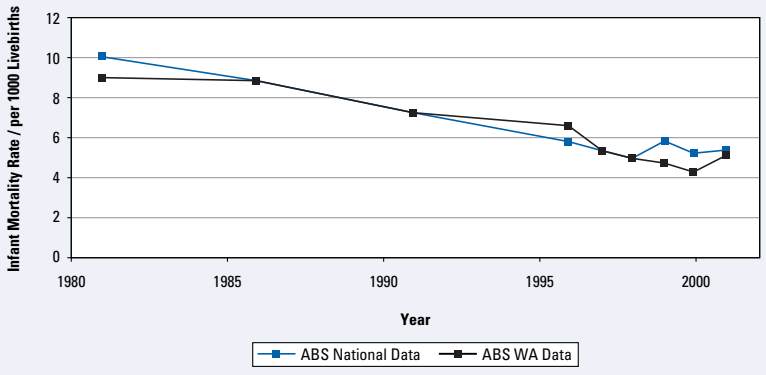
- **Efforts to create national uniformity in methods of data collection, coding and analyses should be supported in order to improve national perinatal statistics.**

5.3 Trends in Infant Mortality in WA and Nationally

During the 20th century, the rate of infant deaths in Australia decreased from a documented 103 deaths per 1,000 live births in 1900 to 5.3 deaths per 1,000 live births in 2001.[9]

As with perinatal mortality, there are discrepancies between states in the information available on infant deaths. ABS mortality rates are calculated by an indirect statistical estimation method.[9] WA rates compare favourably with national rates for infant mortality (Figure 11 and Table 15).

Figure 11: Infant Mortality Rates, WA vs National 1981-2001



ABS data[9]

Table 15: Trends in Infant Mortality Rates by State, 1981-2001

Year	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	AUST
1981	10.2	9.3	8.6	8.0	8.9	12.3	23.5	8.9	10.0
1986	9	8.6	6.5	7.4	8.8	11.4	16.0	8.5	8.8
1991	7.2	6.5	7.6	5.5	7.2	9.0	14.2	7.6	7.1
1996	5.8	5.0	6.4	4.9	6.5	4.5	11.5	5.7	5.8
1997	5.2	4.9	5.8	4.7	5.3	6.5	12.5	3.8	5.3
1998	4.3	4.7	6.4	4.0	5.0	5.7	12.4	6.0	5.0
1999	5.8	5.6	5.7	4.3	4.7	7.6	11.7	5.6	5.7
2000	5.2	4.5	6.2	4.6	4.3	5.8	11.7	4.2	5.2
2001	5.3	4.8	5.9	4.6	5.1	6.2	10.7	3.0	5.3

ABS[9]

5.4 Causes of Infant Mortality

There are significant differences in the rates of death in the neonatal versus post-neonatal period. Most deaths of preterm babies occur in the neonatal period.

National figures during the 15 year period 1982-1996 attributed 62% of neonatal deaths to perinatal conditions (hypoxia, birth asphyxia, fetal growth problems) and 33% to congenital abnormalities.[9] An estimate of the proportion of neonatal deaths attributed to perinatal conditions in WA (2000-01) is 56% (using PSANZ-NDC: extreme prematurity 30%; neurological disorders 13%; cardiorespiratory disorders 13%), and 26% had congenital abnormalities, a figure similar to the national estimates over the earlier time period. Different classification systems are acknowledged.

For post-neonatal deaths, national data give the three leading causes as: SIDS 49%, congenital abnormalities 18% and perinatal conditions 9%. In WA (2000-01) the leading causes of death were: SIDS 31%, "other" (including trauma) 21%, congenital abnormalities 19% and infection 13%, by PSANZ-NDC.

5.5 Preventable Perinatal and Infant Deaths in WA 2000 and 2001

In WA in 2000 and 2001, 52 of the 167 cases investigated by the Committee had one or more preventable factors. This is fewer than found by CESDI which reported that for stillbirths in the UK in the period 1996-97, nearly half had suboptimal care that might have contributed to the outcome.[17]

The Committee suggests that improved knowledge and skills are needed in several areas:

- Management of diabetes in pregnancy
- Management of pre-eclampsia
- Management of twin pregnancy
- Appropriate application and interpretation of electronic fetal heart rate traces
- Technical skills for operative vaginal deliveries, Caesarean section and manoeuvres to manage shoulder dystocia
- Technical skills for resuscitation of the newborn
- Identification and appropriate early treatment for neonates at risk of sepsis

The Committee advised "liberal use of consultation with specialists" to assist in the management of perinatal complications, and early referral to appropriately equipped and staffed centres for high-risk patients.

Nearly one fifth of investigated cases with preventability scores ≥2 were found to have "systems" problems. It is likely that this is an underestimate due to the absence of documentation. A case series audit, performed in the manner of this report, is not well designed to identify systems errors such as failure of equipment, as no request has been made for such information to be provided. Hospitals and individual practitioners are encouraged to look at their own quality assurance practices, and identify and remedy systems problems.

Poor quality record keeping was observed in many cases, also noted in the CESDI reports.[17]

Recommendation:

- **Healthcare professionals should be supported in the maintenance of necessary knowledge and skills to care for mothers and infants.**

5.6 Intrapartum Deaths

In Australia, from 1980 to 2000, there was a decline in fetal death rates, with the decline in intrapartum fetal death rates being greater than the decline for antepartum fetal death rates.[8]

The 4th CESDI Report examined UK labour-related deaths in 1994-95. Of the 873 intrapartum deaths, 75% had at least one comment relating to suboptimal 'intrapartum' care. More than half the comments related to failures in the use and interpretation of cardiotocograph (CTG) tracings.[17] As a result of this, the CESDI panel recommended that every hospital provide a regular training program in this area, and improved organisation standards in labour wards. The Report did not comment on the value of routine use of CTG technology. Subsequently, the 8th CESDI Report recorded a significant decline in the number of deaths of babies over 1 kg attributed to intrapartum events, from 1993 to 1999.[17] Further to their observations and enquiries, the CESDI panel have endorsed implementation of guidelines for the use of electronic fetal monitoring.[22]

In WA in 2000 and 2001, eleven of the 21 investigated term intrapartum deaths had some grading of preventability due to medical care, and seven of these related to electronic fetal monitoring issues. Appropriate application and interpretation of electronic fetal heart rate traces may have prevented some deaths. The Committee is supportive of recommendations for continuous electronic fetal heart rate monitoring of particular high-risk groups (Level B Evidence Based Medicine (EBM)) and intermittent auscultation for low-risk labours (Level A, EBM); see Appendix IV.[22-25] These recommendations are detailed in the RANZCOG Clinical Guidelines.[24]

5.7 Rural & Remote Issues

Data from 1998 show that Australian specialist obstetricians and gynaecologists practise mainly in metropolitan areas (84.7% of the workforce), with fifteen percent being located in rural and remote areas where 28.5% of the female population lives. In rural and remote WA there are fewer obstetric specialists/sub-specialists than in rural/remote Australia overall (6.9 compared to 12.7 per 100,000 females aged 15-49 years).[26] Recruitment and retention of appropriately skilled medical and nursing practitioners is a major issue for rural WA.

The particular challenges faced by Western Australia are those of a relatively under-populated but vast state with only one tertiary referral centre, the Women's and Children's Health Service in Perth. Whilst the Royal Flying Doctor Service (RFDS) provides an excellent retrieval and transfer service, enormous pressure is placed on the services at times. In addition, ambulance services in rural areas are often staffed by volunteers.

Despite the size of WA, in the years 2000 and 2001 over 85% of births of babies weighing less than 1500 g, and over 85% births less than 32 weeks gestation occurred in the State's tertiary centre.[27] This is a reflection of good anticipation by medical staff in arranging early transfers, and

of the high quality of transport facilities and care currently in existence. Nevertheless, transport services such as RFDS are under stress and require ongoing support and resources.

Neonatal outcomes are better for preterm babies born in specialised perinatal units.[25] The Committee recommends earlier rather than late transfer of high-risk patients and those in preterm labour, to an appropriate level obstetric hospital.[28]

The Committee considers that an integrated statewide obstetric service may optimally coordinate care for the vast state of WA, assisting in determining appropriate levels of obstetric/neonatal care provided in each hospital, staffing issues, coordinating transfer services, and producing evidence-based practice protocols applicable to each area.

Recommendations:

- **An integrated statewide obstetric service may assist delivery of care for the vast state of WA.**
  This would include:
  - ➔ workforce and infrastructure advice and planning
  - ➔ producing evidence-based practice protocols, applicable to each area
  - ➔ supporting skilled obstetric and paediatric staff in rural areas.
- **Transfer services should be valued and adequately resourced.**
- **Early transfer of high-risk patients is advised.**

5.8 Adverse Maternal Behaviour and Lifestyle Factors

The Committee noted the high proportion of cases where maternal lifestyle factors appeared contributory to deaths.

5.8.1 Smoking

For births in WA in 2000 and 2001, smoking status was unknown in <1% of women. This demonstrates the high level of data collection via the Midwifery Notification Forms.

Smoking during pregnancy is associated with low birthweight, preterm birth and perinatal death.[26,29,30]

There is already a significant public health campaign for the prevention of smoking, with growing community awareness of the associations between smoking, stillbirth and SIDS.

An MJA review in 2001 summarised the current information regarding smoking as follows:

- Smoking doubles the risk of having a low birthweight baby and significantly increases the rate of perinatal mortality and several other adverse pregnancy outcomes.
- The mean reduction in birthweight for babies of smoking mothers is 200 g.
- High-quality interventions to help pregnant women quit smoking produce an absolute difference of 8.1% in validated late-pregnancy quit rates.
- If abstinence is not achievable, it is likely that a 50% reduction in smoking would be the minimum necessary to benefit the health of mother and baby.
- Healthcare providers perform poorly in antenatal interventions to stop women smoking. Midwives deliver interventions at a higher rate than doctors.
- The efficacy of nicotine replacement therapy has not been established in pregnancy. Currently, its use should only be considered in women smoking more than 10 cigarettes per day who have made a recent, unsuccessful attempt to quit and who are motivated to quit.
- Relapse prevention programs have shown little success in the postpartum period.[30]

The Committee encourages ongoing public health initiatives to dissuade women from smoking, particularly during pregnancy.

5.8.2 Alcohol

In Australia there is no standardised data collection instrument or data definition for alcohol consumption in pregnancy.[26]

In 14 of the 167 cases investigated in WA in 2000 and 2001, maternal alcohol abuse was thought to be a significant contributing factor to fetal and infant deaths. Data regarding alcohol use were obtained in 52% of the cases investigated by the Committee. Unlike smoking, the majority of births do not have data collected about alcohol use because this question is not listed on the Midwifery Notification Forms. It is likely that alcohol abuse is considerably underestimated due to concealment from health professionals, as well as a lack of data ascertainment.

Maternal alcohol abuse is associated with adverse perinatal outcomes, including fetal alcohol syndrome, alcohol withdrawal in the newborn, and increased risk of perinatal mortality.[31,32]

Women's knowledge of the risks associated with alcohol consumption during pregnancy appears to be limited. A study conducted in Perth found that a minority (22%) of women knew about fetal alcohol syndrome (FAS), 30% thought it was safe to drink above recommended guidelines during pregnancy, and around 30% intended to drink during future pregnancies. There was a positive relationship between knowledge of FAS and the level of education attained. The study found that medical advice on the consumption of alcohol during pregnancy had been received by less than a third of women who had been recently pregnant and less than a quarter of women pregnant more than four years prior to the study.[33]

The American Academy of Family Physicians recommends that women who are planning to have a child and women who are pregnant should abstain from the consumption of alcohol to avoid adverse risks to the unborn child.[34] The Australian National Health & Medical Research Council (NHMRC) recommends that women should consider not drinking at all during pregnancy, or should limit consumption to a maximum of seven standard drinks per week (see Guideline 6.3).[35] The Royal College of Obstetricians & Gynaecologists (UK) recommends no more than one standard drink per day during pregnancy.[36]

The Committee encourages doctors to enquire about alcohol usage and recommends minimal use or abstinence during pregnancy. Level B evidence-based recommendations suggest that a multidisciplinary approach is valuable in the treatment of heavy drinkers, and that help to cease drinking should be given to all "at risk" groups.[25]

5.8.3 Illicit drug use during pregnancy

Of the cases investigated in WA in 2000 and 2001, 8.4% were associated with maternal illicit drug abuse, which may have contributed to a proportion of fetal and infant deaths. As with alcohol, there is little information collected about illicit drug use during pregnancy, and usage is likely to be underestimated. Due to social and legal concerns, it is likely that some patients conceal their drug habits.

The National Drug Strategy Household Survey in 2001 provides some information. Of the pregnant/ breastfeeding women surveyed, 8% reported using an illicit drug in the previous 12 months, compared with 20% of women who were not pregnant/ breastfeeding in the previous 12 months. Of those women who used illicit drugs, about half used marijuana only and about half used another illicit drug, or combination of drugs.[37]

Risks from illicit drug use are difficult to quantify. A meta-analysis, incorporating seven individual studies, found that there was an increased risk of neonatal mortality in infants of women using heroin (RR 3.27) or both heroin and methadone (RR 6.37) during pregnancy. However, women who received methadone treatment only during pregnancy did not have a significantly increased risk of neonatal mortality.[26,38]

Associated with intravenous drug addiction are significant risks from blood-borne infectious diseases, poor nutrition, poverty and domestic violence.

The Committee suggests routine enquiry about drug use during pregnancy. Patients with chemical dependency problems may best be managed with a multi-disciplinary approach (Level B, EBM).[25]

Recommendations:

- **Thorough history taking is encouraged, enquiring about smoking, alcohol and drug use.**
- **Consideration should be given to routine collection of data regarding alcohol and illicit substance use during pregnancy.**

5.9 Reducing Perinatal and Infant Mortality Rates

The major causes of perinatal mortality are prematurity due to spontaneous preterm births, congenital malformations and "unexplained" antepartum stillbirths. The major cause of post-neonatal mortality is SIDS.

5.9.1 Preterm Births

Preterm birth remains a major cause of perinatal deaths. The NPSU reported the rate of preterm deliveries (<37 weeks gestation) in Australia as 7.9% in the year 2000.[8] In WA in 2000 and 2001, 8.2% of deliveries were preterm.

In developed nations, complications of prematurity account for the majority of perinatal mortality and morbidity in infants without congenital abnormalities. In the USA, prematurity-related disorders cause more than 70% of fetal and neonatal deaths. USA data show that the rate of low birthweight deliveries increased between 1989 and 1997. Reasons for this increase may include: higher rates for preterm birth in black women, increased multiple births, greater willingness to deliver preterm infants when maternal complications occur, improved ascertainment of gestational age by ultrasound imaging and increased registration of extremely immature deliveries.[39]

Advances in neonatal care have led to increased survival rates. The 8th CESDI Report showed a high rate of survival to day 28 of 88% in babies 27-28 weeks gestation in 1998-2000 in the UK.[17] Similarly, in Australia there have been major advances in survival, but the proportion of fetal deaths due to preterm birth has remained virtually static in Australia in the last two decades. In 1980 preterm births of less than 37 weeks gestation comprised 66.8% of fetal deaths in Australia; in 2000 the proportion was 71.6%.[8] In WA in 2000 and 2001, 80.1% of stillbirths and 76.1% of neonatal deaths occurred in preterm deliveries.

Strategies aimed at the prevention of preterm birth are controversial and require further evaluation. The NHMRC publication "Care around preterm birth" provides a detailed discussion and guidelines on best practice in this important area.[40]

5.9.2 Congenital Abnormalities

Reducing deaths due to neural tube defects can be achieved by good nutrition and folic acid supplementation in the peri-conceptual period (Level A, EBM).[25,41-42]

Reported death rates are reduced by early detection of anomalies with some anomalies being amenable to treatment and others resulting in the choice of termination of pregnancy. Level B evidence-based recommendations include first trimester screening (Level B, EBM).[25]

Routine anatomy scan by an appropriately-trained and accredited service provider is also well supported (Level A, EBM).[25]

5.9.3 Unexplained Antepartum Stillbirths

"Unexplained" does not mean that all these deaths are necessarily "unavoidable". This group includes women who have had little or no antenatal care, inadequate antenatal tests, and those with inadequate investigations following stillbirth (CESDI 8th report[17]). However, for most women with an unexplained stillbirth, there are no identified risk factors.

"Unexplained antepartum stillbirths" are best thought of in two groups: "unexplored" and "truly unexplained". Improved use of laboratory investigation following stillbirth would decrease the number ultimately coded as "unexplained". In particular, as shown in the WA data for 2000 and 2001 in this report, the perinatal autopsy may significantly contribute to understanding of the clinical picture allowing classification of a specific cause of death.

5.9.4 Sudden Infant Death Syndrome

SIDS is a complex problem and probably represents a number of conditions resulting in sudden death.[43] There has been a significant reduction in deaths from SIDS in Australia since the introduction of the "Reducing the Risks" program in 1991, with the SIDS death rate dropping from 1.91 (1991) to 0.68 (1997) and 0.41 (2001) per 1,000 livebirths.[9,44] Similarly, data from the USA show a 40% reduction in SIDS rates between 1992 and 1998, with a national "Back to Sleep" program.[43]

Higher rates of SIDS in Aboriginal infants have been documented previously.[45,46]

Ongoing education regarding the risks of sleeping in the prone position and avoidance of smoking is recommended, with particular reference to Aboriginal people. The benefits of breastfeeding should be emphasised.

An association is observed between co-sleeping and infant deaths.[45,47-50]

The Women and Children Division of Flinders Medical Centre, Adelaide, has produced educational brochures for health professionals and families regarding the risks of co-sleeping, particularly with reference to the risks of co-sleeping when very fatigued or intoxicated (see Guideline 6.4).[49] These guidelines were published by the South Australian Maternal, Perinatal and Infant Mortality Committee in 2002. The PN&IMC recommends consideration of the use of similar educational material in WA.

Recommendations:

- **The importance of social risk factors in parenting should be highlighted.**
- **Public health programs should continue to educate regarding:**
  - **➔ periconceptional folate**
  - **➔ compliance with antenatal care**
  - **➔ the risks of smoking, alcohol and drug use**
  - **➔ the benefits of breastfeeding**
  - **➔ safer sleeping practices, with particular attention to risks of co-sleeping.**

5.9.5 Other Post-Neonatal Deaths

Whilst small in numbers, this group includes other "preventable" deaths including those due to trauma, vaccine-preventable illnesses, choking and drowning. Health professionals are encouraged to remind parents of safety issues and vaccination in order to help reduce these types of deaths.

5.10 Racial Differences in Perinatal and Infant Mortality Rates

WA has a high proportion of Aboriginal people. The only state or territory with a higher percentage of Aboriginal mothers is the Northern Territory (Table 16).

Table 16: Aboriginal Mothers by State, 1998-2000

	% of all mothers in each state/territory
Western Australia	6.0
New South Wales	2.4
Victoria	0.7
Queensland	5.8
South Australia	2.4
Tasmania	1.4
Northern Territory	36.5
Aust Capital Territory	1.3
Australia	3.4

ABS[52]

The WA data for 2000 and 2001 show significantly higher rates of stillbirths (13.8 versus 7.0 per 1,000 births), neonatal (7.1 versus 2.5 per 1,000 livebirths) and post-neonatal deaths (7.8 versus 1.3 per 1,000 livebirths) in the Aboriginal population compared with the non-Aboriginal population. Among Aboriginal infants, the relative risk of death compared with non-Aboriginal infants increases with age, which may reflect longer exposure to the well-documented poorer social and environmental conditions of many Aboriginal infants.[51,52]

Australian data show that Aboriginal mothers are more likely to have their babies at younger ages than non-Aboriginal mothers, and to have a low birthweight baby. The national perinatal mortality rate for Aboriginal people remains at about twice the rate for non-Aboriginals, but varies considerably across states and territories.[52]

The infant mortality rate for Aboriginal infants in combined data from Queensland, WA, SA and Northern Territory was 2.5 times greater than for non-Aboriginal infants in 1999-2000, with Aboriginal death rates from SIDS, respiratory and cardiovascular disorders and accidents being approximately four-fold those of the non-Aboriginal rates. ABS national data for 2001 reported 10.6 Aboriginal infant deaths per 1,000 livebirths, compared to 5.3 per 1,000 for the total population, but commented that measures of Aboriginal mortality are thought be underestimated.[9]

Very high mortality rates in some rural regions in WA reflect areas where a higher percentage of the population is Aboriginal. WA data for births in 1980-1993 have shown Aboriginal mortality rates before the first birthday being 2.7 times greater than those for non-Aboriginal infants.[46] The trends in WA data from 1980-1998 show that the discrepancy between Aboriginal and non-Aboriginal infant mortality rates is increasing.[53] (See Educational & Discussion Papers: Indigenous Infant Mortality: 1980-1997).

Cultural, economic, social and behavioural factors may all contribute to excess mortality risks for Aboriginal infants.[54]

The Committee noted cases where Aboriginal women had little or no antenatal care, often through non-attendance at scheduled appointments. Problems related to living in remote areas, poverty, poor nutrition and substance abuse were also observed.

Recommendations made by the NHMRC (1996) note that:

- Improving indigenous health generally should be recognised as a crucial step in improving the outcomes of childbirth for Aboriginal and Torres Strait Islander women.
- Indigenous women leaders in each region should be involved in planning maternity services. In some regions it may be appropriate to provide birthing centres.
- Indigenous women representatives should be appointed to liaison committees representing the consumers of major obstetric hospitals.
- Priority needs to be given to increasing the number of indigenous birth attendants, midwives and obstetricians.[52,55]

The Committee supports initiatives to further educate and assist Aboriginal/indigenous people, highlighting:

- The need for culturally appropriate and accessible antenatal care, specifically targeting poor nutrition and alcohol use.[56,57]
- Awareness and management of diabetes.
- Efforts to reduce the use of alcohol, smoking and drugs during pregnancy and breastfeeding.
- Safer sleeping practices.
- A need for greater accommodation options for families required to travel to a higher level centre to obtain appropriate medical care.

Recommendation:

- **Innovative programs are required to address the high rates of Aboriginal mortality. In particular, culturally appropriate education programs targeting nutrition, diabetes mellitus and alcohol abuse are recommended.**

5.11 Routine Antenatal Care

Guidelines for the provision of antenatal care vary. There have been no comprehensive national guidelines on antenatal care since the NHMRC rescinded its guidelines in 1995. National guidelines based on evidence-based reviews may be helpful.[58] The Committee promotes the guidelines based on best available evidence. Assistance is available on-line through the Women's and Children's Health Service. Some guidelines are also available on the Royal Australian New Zealand College of Obstetrician and Gynaecologists (RANZCOG) website.

Evidence Based Clinical Guidelines:
http://wchs.health.wa.gov.au/development/manuals/guidelines.htm
http://www.ranzcog.edu.au/

5.12 Appropriate Investigations following Stillbirth and Neonatal Death

5.12.1 Benefits of Autopsy

The clinical relevance of the perinatal autopsy is well documented. It significantly contributes to making a diagnosis of cause of death, and provides additional information.[59-65] The "autopsy utility scale" adopted by this Committee was used in a JAMA review of 124 perinatal deaths with autopsy. In that review, in 42% of cases the autopsy findings were confirmatory of the clinical diagnoses; in 27% the autopsy changed the diagnosis, in 7% it added information and in 24% the autopsy was inconclusive.[12] The comparable percentages in these WA data are: 25%; 21%; 31% and 23%, helping to quantify the benefits of this investigation.

Autopsy examinations were undertaken in 55.3% of perinatal deaths in WA in 2000 and 2001 (60.2% stillbirths; 42.0% of neonatal deaths), which compares favourably with other states' data. For example, in Victoria in 2001, 37.4% of perinatal deaths had an autopsy examination performed (40.8% of stillbirths and 31.2% of neonatal deaths), which had decreased from 48.5% in the year 2000. In Queensland (Qld) in 1999, autopsy examinations were undertaken in 45.2% of perinatal deaths, which had reduced to 34% in 2001, (Qld 2001 data: 39% of fetal deaths and 26% of neonatal deaths).[66] In SA in 2001, autopsies were performed in 61.4% of perinatal deaths.[49]

5.12.2 Other Investigations

The Committee noted considerable variation in the investigations performed following perinatal death. One may speculate that many of the cases classified as "unexplained stillbirths" could have had a definitive diagnosis had adequate tests been performed (60% had an autopsy; 20% Kleihauer-Betke; 48% had cultures taken). In a retrospective review of 745 stillbirths in the USA (1990-1994) 31% of fetal deaths were unexplained when autopsy was performed, compared with 44% unexplained when no autopsy was performed (p=0.0002).[59]

The most important aspects of stillbirth evaluation are placental pathology and autopsy. Some tests, such as antinuclear antibody testing, the Kleihauer-Betke test and serological tests (syphilis, toxoplasmosis, rubella, cytomegalovirus and herpes simplex virus) have very low yields of information.[59]

The Committee proposes guidelines for the investigation of a stillbirth or infant death (see Guideline 6.2). It is best to avoid assumptions about the cause of the death which may deny parents a full investigation.[65] For the individual woman, improved knowledge and understanding of any prior poor obstetric outcome may positively influence the medical management of subsequent pregnancies. To avoid excessive costly tests, liaison with a consultant is recommended.

Recommendations:

- Thorough investigation into cause of death is recommended.
- Autopsy is highly recommended and is optimally performed in conjunction with paediatric/perinatal pathologists.

5.13 Bereavement Support

The Committee noted the high level of emotional support offered to grieving parents in WA. Notes documented great care provided by midwives and doctors with counselling, mementos and photos offered to grieving parents. In particular, most cases were immediately referred for social support or other psychological counselling. No cases were highlighted for poor standard of care in this respect.

5.14 Closing remarks – The Future

There are limitations to the Committee's activities. Findings about individual cases may only be conveyed to the attending medical practitioners. The Committee is unable to communicate directly with other health professionals, including midwives, who were involved in cases. In addition, the Committee has no role in reviewing individual cases involving significant morbidity or events other than deaths. A review of the relevant provisions of the *Health Act 1911* which govern the structure and functions of the Committee may lead to expansion of its educational activities.

Recommendation:

- All health providers should be encouraged to audit their broader perinatal and infant health outcomes.

6 Guidelines

6.1 What to do when there is a Stillbirth or Infant Death

1. Make detailed legible notes about the event.
2. Carefully examine the infant and placenta.
   Document relevant "positive and negative" findings.
3. Notify the Executive Director, Public Health, preferably by sending a copy of the Death Certificate to:
   Dr Margaret Stevens
   PO Box 8172, Perth Business Centre, 6849
   Phone: 9222 2295 Fax: 9222 2322
4. Notify the Coroner if required:

   Extract from the Coroners Act 1996:

   *A "**reportable death**" means a Western Australian death –*

   (a) that appears to have been unexpected, unnatural or violent or to have resulted, directly or indirectly, from injury;

   (b) that occurs during an anaesthetic;

   (c) that occurs as a result of an anaesthetic and is not due to natural causes;

   (d) that occurs in prescribed circumstances;

   (e) of a person who immediately before death was a person held in care;

   (f) that appears to have been caused or contributed to while the person was held in care;

   (g) that appears to have been caused or contributed to by any action of a member of the Police Force;

   (h) of a person whose identity is unknown;

   (i) that occurs in Western Australia where the cause of death has not been certified under section 44 of the Births, Deaths and Marriages Registration Act 1998; or

   (j) that occurred outside Western Australia where the cause of death is not certified to by a person who, under the law in force in that place, is a legally qualified medical practitioner.
5. Refer to Guidelines 6.2 for the arrangement of appropriate investigations.
   In particular, encourage the parents to consent to post mortem examination. There are options for full and modified (such as external examination only) postmortem examinations.
   Contact the pathology technician at King Edward Memorial Hospital (KEMH) on 9340 2730 to arrange for appropriate transfer of the body. Take microbiological swabs of the placenta prior to transfer. Do not put the baby or placenta in formalin.
   Multi-lingual information brochures and consent forms may be obtained on-line:
   http://www.health.wa.gov.au/postmortem/
6. "De-brief" for staff involved in the case.
   This will depend on the hospital involved. Where possible, it is preferable for hospitals to review cases with poor outcomes, to provide emotional support for involved staff and to reflect on any useful learning experience that may have come from the event.
7. Counselling for the parents.
8. Mementos such as photos and footprints are suggested.
9. Notify the General Practitioner, Child Health Nurse, and/or other relevant care providers.
10. Complete Death Certificates (and Cremation Certificates where required)
11. Consider professional counselling for oneself.

6.2 Appropriate Investigations Following Stillbirth

Thorough investigation into the cause of death is recommended. Even where the cause appears obvious, additional information may be obtained that may assist in the management of the woman and her future pregnancies. In this sensitive period it may be difficult to discuss investigations, but if not requested at the appropriate time, the opportunity to obtain valuable information may be lost.

When fetal death is diagnosed, or following a stillbirth, review the antenatal and peripartum notes with attention to past medical and obstetric history, family history (e.g. genetic disorders/ hypertension/ thrombophilia/ diabetes/ thyroid disease), possible infections, exposure to animals or toxic chemicals, and substance use. History may provide information suggestive of pre-eclampsia, diabetes, cholestasis of pregnancy, or antepartum infection. There should be a review of the routine antenatal blood tests (maternal full blood count and blood group antibody screen), and antenatal infectious disease screening (rubella, syphilis, HIV, Hepatitis B & C).

Autopsy examination of the infant should be encouraged at all times. Where parents decline full autopsy, options for "external only" or a step-wise approach are available. Placental histopathology provides much information, and most parents will consent to this even if they decline autopsy examination. Where autopsy is declined, consent should also be sought for metabolic studies using a blood spot (collected on a Guthrie card), x-ray (babygram) and clinical photographs of the infant.

Postmortem ultrasound (either in utero or ex utero) provides anatomical information which is particularly useful for the pathologist for assessing intra-cranial anatomy, as the brain is often autolysed and difficult to examine. Amniocentesis samples are recommended for karyotyping and microbiology. Samples of tissues collected postmortem have a high failure rate for chromosomal studies, so samples obtained earlier through amniocentesis are recommended. Amniotic fluid samples also provide helpful microbiological information where there is a question of ascending genital infection or viral infection.

For stillbirth of a hydropic fetus, discussion with a maternal fetal medicine specialist is recommended in order to tailor specific investigations.

The Kleihaeur-Betke test is recommended as a routine. This test detects fetal blood cells in the maternal circulation, indicating feto-maternal haemorrhage. This test is of little use unless performed prior to the onset of labour.

A measurement for glycated haemoglobin (HbA1C) is suggested to assist in diagnosis of diabetes. Women with unexplained stillbirth have an increased risk of glucose abnormalities in subsequent pregnancies. Therefore, if gestational diabetes mellitus is suspected, formal glucose testing should be undertaken in the next pregnancy.

In the presence of pre-eclampsia, maternal liver function, uric acid and coagulation studies may be indicated. In the presence of maternal pruritus, check maternal serum bile acids and liver function.

It is recommended to routinely perform urine toxicology screening for illicit substances but consent should be obtained for this.

Placental swabs are recommended as a routine. Other microbiological swabs (maternal high vaginal, endocervical and throat swabs) and maternal blood cultures are only recommended in the presence of maternal fever. Routinely recommended maternal serological tests are for Cytomegalovirus, Toxoplasma gondii, Parvovirus B19 and Herpes simplex virus. Testing for syphilis and other infectious diseases is suggested where clinically indicated.

Six weeks following a perinatal loss, consultant liaison is advised in order to tailor investigations appropriately. Note that thrombophilia screening and auto-immune studies are only recommended in the presence of placental pathology and/or evidence of fetal growth restriction. These costly investigations have a low yield.

For neonatal deaths, many of the above investigations will be appropriate. Liaison with a paediatrician is recommended to assist in appropriate investigations.

Consultant Advice:

Perinatal Loss Service:
King Edward Memorial Hospital
Coordinator: Phone 9340 2222, page 3430, or 9340 2128
or page on-call Senior Registrar in Obstetrics, via switchboard 9340 2222

Neonatal deaths:
Princess Margaret Hospital for Children
Page the on-call Neonatal Intensive Care Consultant, via switchboard 9340 8222

Post-Neonatal deaths:
Princess Margaret Hospital for Children
Page the on-call Paediatric Intensive Care Consultant, via switchboard 9340 8222

Investigations Following Stillbirth:

Prior to induction of labour or as soon as possible after stillbirth:

- Maternal blood tests:
  - full blood picture
  - coagulation screen (where clinically indicated)
  - blood group antibody screen (where clinically indicated)
  - Kleihaeur-Betke test (before the onset of labour where possible)
  - glycated haemoglobin
  - glucose
  - liver function, uric acid (where clinically indicated)
  - serology: Cytomegalovirus, Herpes simplex virus, Toxoplasma gondii, Parvovirus B19
  - Serology (where clinically indicated): Rubella virus, Treponema pallidum
- Obstetric ultrasound and amniocentesis
- Maternal urine toxicology screen
- In the presence of maternal fever >38 degrees Celsius,
  maternal samples:
  - high vaginal swab
  - endocervical swab
  - blood cultures
  - throat swab

After delivery:

- Careful examination of the infant
- Autopsy
  If autopsy is declined, consider:
  - blood spot test (Guthrie card)
  - babygram (x-ray)
  - infant ear and throat swabs for microbiology tests
- Cranial ultrasound of infant (if not already performed in utero)
- Placental histopathology and swab for microbiology tests

6 weeks postnatal:

- Consultant liaison recommended
  Consider additional tests where clinically indicated, such as:
  - convalescent serology
  - thrombophilia screening
  - glucose tolerance testing
  - auto-immune tests

6.3 Alcohol Use During Pregnancy

Screening for Alcohol Use During Pregnancy

The RCOG (UK) clinical practice guidelines[36] comment on the need for obstetricians to be aware of alcohol abuse during pregnancy, and suggest screening for alcohol use during pregnancy; this may be applied to the whole population or just those women with growth- impaired fetuses. The demonstrated most effective way of detecting risky alcohol consumption is the T-ACE questionnaire.[68]

T = How many drinks does it take to make you feel high? (Tolerance) (two points: the patient is considered tolerant if it takes more than two drinks to make her high)

A = Have people annoyed you by criticising your drinking? (one point)

C = Have you ever felt you ought to cut down your drinking? (one point)

E = Have you ever had a drink first thing in the morning to steady your nerve or rid yourself of a hangover (eye opener)? (one point)

A total score of greater than or equal to two points is considered positive and identifies over 70% of heavy drinkers during pregnancy.

Australian Guidelines for Alcohol use During Pregnancy

The Australian Alcohol Guidelines[35] recommend that women who are pregnant or might soon become pregnant:

- may consider not drinking at all
- most importantly, should never become intoxicated
- if they choose to drink, they should have fewer than seven standard drinks in a week, AND, on any one day, no more than two standard drinks (spread over at least two hours)
- should note that the risk is highest in the earlier stages of pregnancy, including the time from conception to the first missed period

6.4 Co-sleeping While Breastfeeding

Advice to Health Professionals

Bed sharing while breastfeeding has been associated in some studies with unexpected infant death. This was usually when the mother was very fatigued or under the influence of alcohol or drugs and therefore difficult to arouse once asleep. The mechanism is not thought to be the mother physically compressing the infant, but rather the breast interfering with the infant's airflow. Some infants are particularly susceptible to respiratory arrest from minor airway occlusion. Bed sharing with a parent who smokes (even if not smoking in bed and not breast feeding) increases the risk of sudden infant death syndrome (SIDS).

Recommendations:

1. Mothers are encouraged to sit up, in or out of bed, with a light on while breastfeeding at night. When a mother is unable to sit up unassisted, breastfeeding should be supervised.
2. Mothers who are taking sedative medication or who are excessively fatigued are to be supervised while breastfeeding.
3. A pre-requisite to unattended breastfeeding is a verbal assurance from the mother that clarifies to the staff that the mother is in no significant discomfort, is lucid and feels competent to breastfeed.
4. Infants should sleep in a cot next to their mother's bed when she is sleeping.
5. Pregnant women should receive written information antenatally about the risks when breastfeeding and sedated or fatigued, and about co-sleeping especially if a parent is a smoker. This information should be included in any breastfeeding information which is distributed in antenatal clinics or antenatal classes.

Advice to Parents on Sleeping in the Same Bed as their Baby

Bed sharing while breastfeeding has been associated in some studies with unexpected infant death. This has usually been when the mother was very fatigued or under the influence of alcohol or drugs and therefore difficult to arouse once asleep. The mechanism is not thought to be the mother physically compressing the infant, but rather the breast interfering with the infant's airflow. Some infants are particularly susceptible to respiratory arrest from minor airway occlusion. Bed sharing with a parent who smokes (even if not smoking in bed and not breastfeeding) increases the risk of sudden infant death syndrome (SIDS).

Recommendations:

1. If you plan to bring your baby to bed, sit up with a light on while breastfeeding.
2. If you are unable to sit up, are taking medication that sedates you, or are excessively tired, it would be a good idea to have someone else in the room while you are breastfeeding.
3. When you plan to go to sleep, it may be better to put your baby in a cot next to your bed.
4. If you decide to keep your baby in your bed, the mattress should be firm. Soft quilts or pillows should not be placed under your baby. He/she should be placed on his/her back and waterbeds should not be used.
5. If you smoke or have smoked during your pregnancy, it would be better if you didn't share a bed with your baby, as this has been associated with an increased risk of SIDS.

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Educational & Discussion Papers

Stabilisation and Transfer of the Sick Neonate

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Recognition and Stabilisation of the Sick Neonate

The Western Australian Neonatal Transport Service (WANTS) provides appropriately trained medical and nursing staff with specialised equipment to stabilise and transport the sick neonate from community hospitals to either of the two neonatal intensive care units in Western Australia; (Princess Margaret Hospital for Children-PMH, and King Edward Memorial Hospital-KEMH).

The service was developed primarily for sick neonates who require transport to these hospitals, but also provides a service for transferring infants back to their referring hospital. WANTS operates over the entire area of Western Australia and is assisted by St. John Ambulance Association and the Royal Flying Doctor Service. The retrieval team is based at PMH. Most neonates are transported to PMH but infants who are very small (<1500 g) or <32 weeks gestation will be transported to KEMH for care. The paediatricians in both the Pilbara and Kimberley regions are also part of the WANTS team and transfer sick neonates from these regions to Perth and sometimes Darwin.

The transfer of the critically ill neonate requires communication between referring hospital staff, the retrieval team and receiving unit, and the stabilisation of the infant by the referring hospital staff until the retrieval unit arrives. The neonate responds to physiologically stressful situations very rapidly. Hence the recognition and stabilisation of the sick neonate requires personnel to not only have the knowledge to treat the infant, but also the readiness and ability to apply the skills in a situation of great stress.

The rationale for retrieving sick neonates and transferring them to a neonatal intensive care unit is that evidence suggests that centralised intensive care lowers mortality and improves outcome. Generally the advantages of retrieval outweigh the disadvantages, but a high level of supportive care between the referring unit and the receiving centre must be provided. Despite the availability of WANTS, on average it takes the team between 1-4 hours to reach the referring hospital, depending on the mode of transport. A neonatologist is available to discuss any patient management with the referring team, 24 hours a day, and whilst they are waiting for the WANTS team to arrive. However, the referring team should be aware of the guidelines for referring neonates and how to resuscitate a neonate.

The following are suggested clinical indications for referral of neonates for intensive care. The referring hospital must assess their own capabilities, facilities and available nursing staff for managing sick neonates. These will vary between hospitals.

1. **Respiratory distress**
   - i) neonates needing more than 30% oxygen for more than 3-4 hours
   - ii) neonates with prolonged (>48 hours) oxygen requirement – for investigation
   - iii) complicated respiratory distress, e.g. associated polycythemia, apnea, hypoglycaemia, congenital anomalies
   - iv) suspected early onset sepsis or moderate to severe meconium aspiration

2. **Low birth weight (<2500 g)**
   i) transfer all babies <1500 g or <32 weeks
   ii) neonates 1500-2500 g (32-35 weeks) and those with severe growth restriction should be in a centre where specialist paediatric medical and nursing facilities are available
   iii) any liveborn very low birth weight infant (<1500 g), regardless of suspected gestation, should be discussed with a neonatologist
3. **The "Unwell" infant,** i.e. lethargy, fever/hypothermia, poor cry, poor circulation, blue spells. Aetiology includes sepsis and metabolic disease
4. **Persistent hypoglycaemia** not responding to frequent oral feeds, especially in neonates of diabetic mothers, IUGR or prematurity
5. **Seizures or apnea**
6. **Hypoxic Ischaemic Encephalopathy.** Neonates who remain depressed following delivery; consider transfer whenever an infant has required intubation and assisted ventilation for more than a few minutes during resuscitation, or remains neurologically abnormal after birth
7. **Suspected congenital heart disease** – note especially inability to achieve an oxygen saturation of >90% with head box oxygen
8. **Severe or multiple anomalies** or any infant in need of special diagnostic and/or therapeutic services.
9. **Abdominal abnormalities,** eg. bile stained vomiting, abdominal distension, failure to pass meconium in the first 48 hours
10. **Jaundiced neonates** who may require exchange transfusion
11. **Neonates bleeding** from any source

Basic stabilisation of the neonate before the WANTS team arrives involves the "ABCD" (airway/breathing/circulation/drugs) of resuscitation, with a few additional steps. While waiting for WANTS, the referring team should continue observation, keep the baby warm and pink, monitor the blood glucose, be sure that respiration is adequate, and commence parenteral antibiotics.

One of the major causes of neonatal morbidity and mortality is sepsis, particularly from Group B Streptococcus. A neonate who is infected may present with virtually any symptom – preterm birth, temperature instability, lethargy, mottled skin, poor feeding, abdominal distension, vomiting, mild or severe respiratory distress, seizures, apneas, and/or hypoglycaemia. **It is most important** that they are commenced on parenteral antibiotics at the earliest time possible, as this can modify the course of illness and decrease morbidity and mortality. Whilst it is preferred that blood cultures are collected prior to administering antibiotics, antibiotics should not be delayed if a blood specimen cannot be obtained.

Antibiotic Dose Regimen: Ideally these are given intravenously, but may be given intramuscularly when there is no intravenous access.

Amoxicillin: 50 mg/kg/dose 12 hourly for the first week,
then 6 hourly for infants older than one week of age

Gentamicin: <30 weeks gestation – 2.5 mg/kg/dose 24 hourly
30-36 weeks gestation – 3.5 mg/kg/dose 24 hourly
>36 weeks gestation – 4.5 mg/kg/dose 24 hourly

For infants presenting >1 week of age, (and at least >36 weeks corrected age) 5 mg/kg/dose gentamicin will be adequate until levels are performed. Please note that these are different recommendations than those printed in the booklet "Stabilisation and retrieval of the sick neonate" based on a recent study performed at KEMH and PMH, and for ease of administration.

If meningitis is suspected, cefotaxime at 50 mg/kg/dose should be added to the above regimen.

Resuscitation of the Newborn

Resuscitation should not vary whether the patient is newborn or up to a month old. All hospitals managing neonates should have the facilities and the knowledge to be able to manage:

a) Airway
b) Breathing
c) Circulation
d) Drugs
e) Temperature Control

An infant requiring resuscitation for greater than 15 minutes (when normothermic) generally results in an extremely poor prognosis. Resuscitation should not be stopped in an infant who is hypothermic until discussion with senior medical staff and a neonatologist.

Resuscitation equipment should include:

- **Suction catheters:** sizes 6, 8 fg
- **Intranasal oxygen catheters:** size 6 fg
- **Face masks**
- **Emergency pneumothorax kit:** 23 g butterfly, 3-way tap, 10 ml syringe
- **Drugs:** Adrenaline 1:10,000
  Dextrose 10%
  Water for Injection
  Vitamin K
  Naloxone (400 microgram/ml)
  Sodium Bicarbonate
- **Endotracheal tubes:** sizes 2.5, 3.0, 3.5
- **Neonatal stillete:** for intubation
- **Laryngoscope blades:** Miller 0, Seward 1
- **Self-inflating bag:** (Laerdal)
- **Umbilical venous catheter tray:**
  UVC or sterile 6 fg feeding tube
  3-way tap
  Artery forceps
  3 ml & 10 ml Syringes

The following physiological states and congenital abnormalities may also require immediate attention and discussion with the neonatologist. More extensive discussion on management of these problems is available in the booklet "Stabilisation and retrieval of the sick neonate" available through WANTS.

Physiological Problem

- Fluid and electrolyte therapy
- Acidosis
- Shock
- Infection
- Hypoglycaemia
- Seizures
- Pneumothorax

Congenital Abnormality

- Choanal atresia
- Pierre-Robin syndrome
- Congenital diaphragmatic hernia
- Oesophageal atresia and tracheo-oesophageal fistula
- Exomphalos and gastroschisis
- Meningomyelocoele
- Bowel obstruction

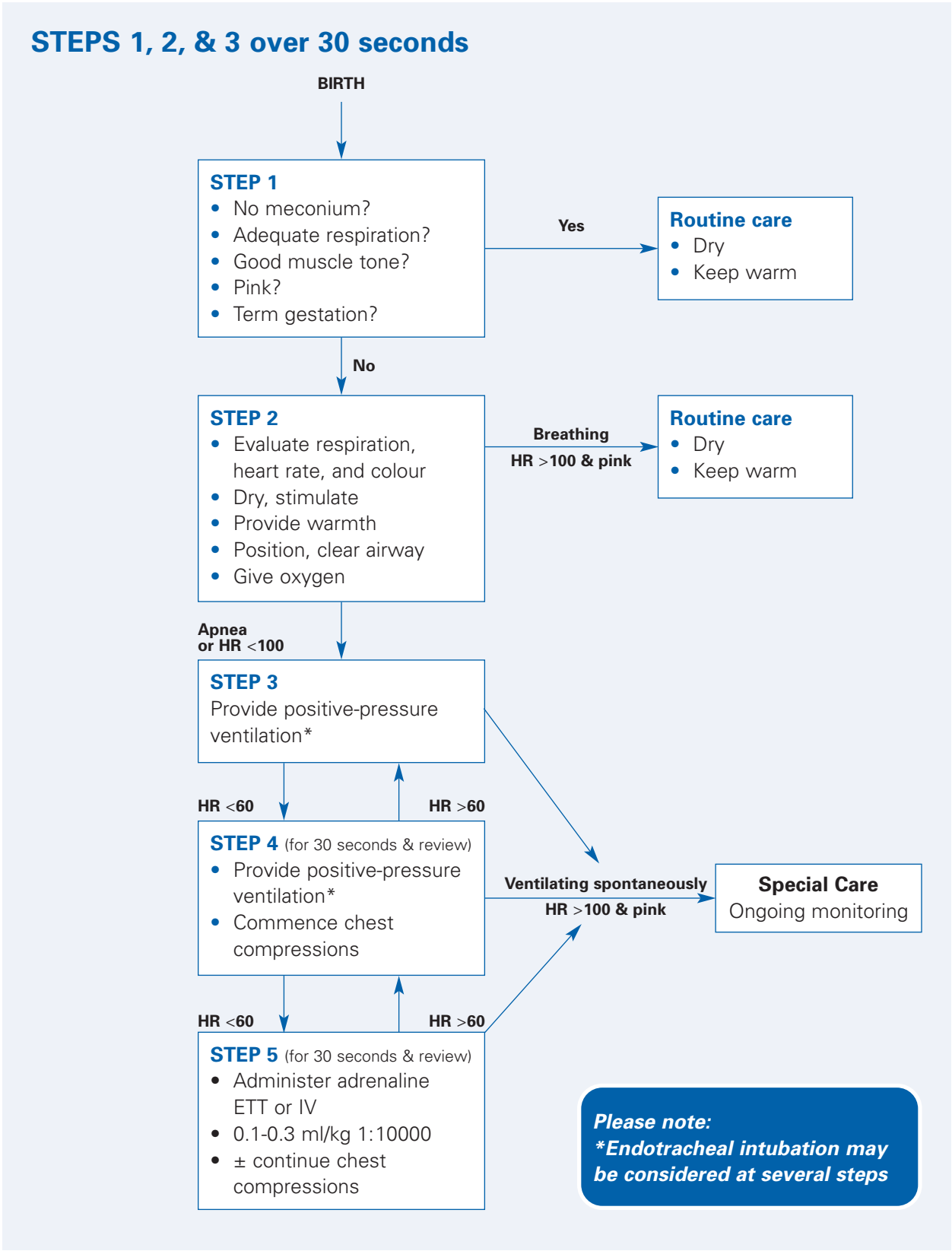
Airway & Breathing

The airway must be clear but repeated aspiration of the pharynx is not required as a routine in a neonate with respiratory distress; aspiration of the nose is rarely required. Excessive suction can cause apnea, bradycardia and hypoxia. Indications for oro-pharyngeal suction include:

- Obvious airway obstruction
- Excessive secretions (meconium or blood)
- Sudden increase in respiratory distress
- Apnea which does not respond immediately to mild stimulation

Suction is not necessary in the neonate who has meconium staining of the amniotic fluid if they are crying, active, and pinking up. If the meconium is thick and the neonate is floppy, bradycardic, apneic and/or has poor perfusion, one should consider endotracheal intubation and applying direct suction to the trachea.

The following algorithm is recommended for resuscitation of the newborn:
(Adapted from Pediatrics, 2000)



Circulation

Urgent intravenous infusion is necessary in the following situations:

- Profound blood loss
- Septic shock
- Symptomatic hypoglycaemia

In many cases the neonatologist can guide referring personnel over the phone through insertion of an emergency umbilical venous catheter (for venous access) in a newborn. A neonate in shock is inactive, pale, floppy, mottled and has weak thready pulses. If shock is due to loss of circulatory fluid, replacement with crystalloid (normal saline) 10-20 ml/kg over 30-60 minutes is used initially, until O negative or cross-matched blood is available.

Shock may be due to decreased cardiac output or poor vascular tone (as in septicaemia), or hypoxic ischaemic encephalopathy with multi-organ involvement. In septicaemia a large amount of volume (40-100 ml/kg) may be required because of peripheral vasodilatation. In situations of perinatal hypoxia, giving too much volume may be deleterious to the heart and may impede cardiac output. In this situation, inotropic support may be required.

Drugs

Adrenaline 1: 10,000 is the primary medication used in neonatal resuscitation. Data supporting the use of higher concentration is inadequate with an increased risk of intraventricular haemorrhage in preterm infants. Adrenaline may be given down the endotracheal tube or intravenously. Intracardiac adrenaline is not recommended.

Sodium bicarbonate is not recommended unless the arrest is greater than 10 minutes and after a blood gas has been obtained and reviewed. It does not treat the cause of the problem unless there is obvious bicarbonate loss (i.e. severe diarrhoea, renal abnormality), but masks the acidosis.

Narcan should only be used if the infant has respiratory depression not responding to usual resuscitation and there is known maternal narcotic administration (pethidine or morphine) within 4 hours of delivery. Repeated doses may be given. **Narcan should not be given to infants of mothers with known narcotic abuse** as it can precipitate seizures and severe morbidity in this situation.

Dextrose

Bolus doses of dextrose should not be given as this stimulates insulin secretion and further compounds hypoglycaemia. To treat hypoglycaemia, an increased concentration of glucose should be used (12% or 15%), at a higher rate (80-120 ml/kg/day), and a repeat blood glucose measurement taken 15-30 minutes after the change. In resistant hypoglycaemia, glucagon 250 microgram intramuscularly may be used repeatedly.

Temperature Control

Hypothermia and hyperthermia can significantly increase neonatal morbidity. Both conditions increase oxygen requirement. Hypothermia may potentiate the problems associated with acidosis, hypoglycaemia and sepsis, while hyperthermia may cause apnea. The preterm neonate has less ability to adjust to unfavourable temperatures. Neonates <2500 g are very susceptible to cold stress and those <1500 g are at extreme risk. Full-term neonates with hypoxic ischaemic encephalopathy should be kept normothermic, due to a greater risk of injury if they are hyperthermic.

Recommended reading

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Eclampsia: The Use of Magnesium Sulphate

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Eclampsia, the occurrence of a seizure in association with pre-eclampsia, remains a rare but serious complication of pregnancy. In the UK, the incidence of eclampsia is 4.9/10,000 maternities. The maternal mortality is 1.8%, and 35% of women will have at least one serious complication. Seizures will occur antenatally in 38%, intrapartum in 18% and postnatally in 44% of women.

The principles of management of eclampsia are to firstly stabilise the woman with respect to seizure prophylaxis, hypertension, fluid balance and clotting abnormalities, and then to assess fetal viability and wellbeing before deciding on the method, timing and place of delivery.

1. Stabilise the woman

a) Immediate management

Place the woman in the left lateral position and secure the airway.

b) Treatment and prophylaxis of seizures

Initial seizure

Make up a solution of 40 g of Magnesium Sulphate (MgSO4) in 500 mls of normal saline solution. Treatment of an initial seizure is a loading dose of 4 g over 20 minutes (this equates to 50 ml over 20 minutes at a rate of 150 ml/hr). This is followed by an infusion of 1 g/hour (12.5 ml/hr) for 24 hours after the last seizure. MgSO4 can be administered intramuscularly if intravenous access is not possible, but this method of administration is more painful and has an increased risk of abscess formation.

Recurrent seizures

Give an additional 2 g (for women <70 kg weight) or 4 g (for women >70 kg) of MgSO4 intravenously over 5 minutes (300/600 ml/hr). If recurrent seizures occur despite magnesium treatment, further treatment options include diazepam (10 mg intravenously) or thiopentone (50 mg intravenously).

Magnesium toxicity

The main side effect of Mg toxicity is respiratory depression/respiratory arrest. Magnesium levels should be monitored by the presence of deep tendon reflexes and respiratory rate. Respiratory depression can be treated with 1 g calcium gluconate intravenously over 3 minutes. Magnesium is renally excreted and toxicity is more likely in the presence of oliguria.

Contraindications to MgSO4 – myasthenia gravis, heart block
Interactions – nifedipine

Magnesium sulphate is associated with a substantial reduction in the recurrence of convulsions when compared to diazepam, for the care of women with eclampsia, relative risk (RR) 0.45, 95% confidence intervals (CI) 0.35-0.58. This means that, on average, for every seven women treated with magnesium sulphate rather than diazepam, one recurrence of convulsions will be prevented (95% CI 6-10). Eclampsia is better controlled by magnesium sulphate than by either diazepam or phenytoin.

c) Treatment of Hypertension

Blood pressure over 160/110 should be treated to reduce the risk of cerebrovascular accident. The aim should be a diastolic blood pressure between 90 and 100.

Treat with Hydralazine 5 mg slowly intravenously, repeated every 20 minutes to a maximum of 20 mg.

d) Fluid balance

Fluid balance should be strictly monitored, with careful attention paid to the risks of fluid overload and pulmonary oedema in the presence of oliguria (<30 mls per hour urine production).

e) Investigations

Eclampsia is usually a multi-system disorder associated with HELLP syndrome (haemolysis, elevated liver enzymes, low platelets), renal failure, and disseminated intravascular coagulation (DIC). Assessment of haemoglobin, platelets, renal function, liver function and coagulation should be performed as a baseline and repeated according to clinical condition.

f) Ongoing management

High-dependency care will be required for at least 24 hours after delivery. Transfer to a tertiary setting should be considered.

2. Deliver the fetus

Timing, mode and place of delivery will depend on factors including gestational age, fetal wellbeing, cervical findings, fetal presentation and paediatric services. Fetal bradycardia is common during maternal seizure activity and can usually be managed with maternal stabilisation.

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Indigenous Infant Mortality: 1980-1997

Dr Jane Freemantle
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Introduction

The following paper provides a summary of the patterns and trends of Aboriginal infant mortality and the comparison with their non-Aboriginal peers between 1980 and 1998[1]. The cohort includes all infants liveborn in Western Australia (WA) between 1980 and 1997 inclusive and who died before 1999. The primary source of the data was the linked population database WA Maternal and Child Health Research Database (MCHRDB).[2]

Summary

Between 1980 and 1998:

- **Sixteen percent of infant deaths were Aboriginal**, while **6% of livebirths** were to Aboriginal mothers.

And there was a:

- **Decrease in the cumulative mortality rate (CMR) in the total WA population in both Aboriginal and non-Aboriginal populations.**
- **Increase in the disparity of risk of infant mortality between Aboriginal and non-Aboriginal infants** over the past two decades, being due to **increase in the disparity in post-neonatal mortality** between the two populations. (The disparity in neonatal mortality remained the same.)
- **Higher post-neonatal mortality rate than neonatal mortality rate in Aboriginal infants**, unlike the non-Aboriginal pattern of infant mortality.*
- **Greater disparity in potentially preventable mortality such as infection and sudden infant death syndrome (SIDS)** compared with causes such as the sequelae of prematurity and deaths due to birth defects between the two populations.
- **Small increase in the rate of SIDS among Aboriginal infants** whilst a **significant decrease** was observed **among non-Aboriginal infants**.
- **Higher risk of infant mortality** for Aboriginal infants compared with non-Aboriginal infants from the main causes of death in all geographical locations.
- **Greater disparity in the metropolitan area** for deaths attributed to **SIDS** and infection between the two populations.
- **Significantly increased risk *within*** the Aboriginal population and the non-Aboriginal populations for deaths due to infection in **remote** locations compared with the **metropolitan** location.

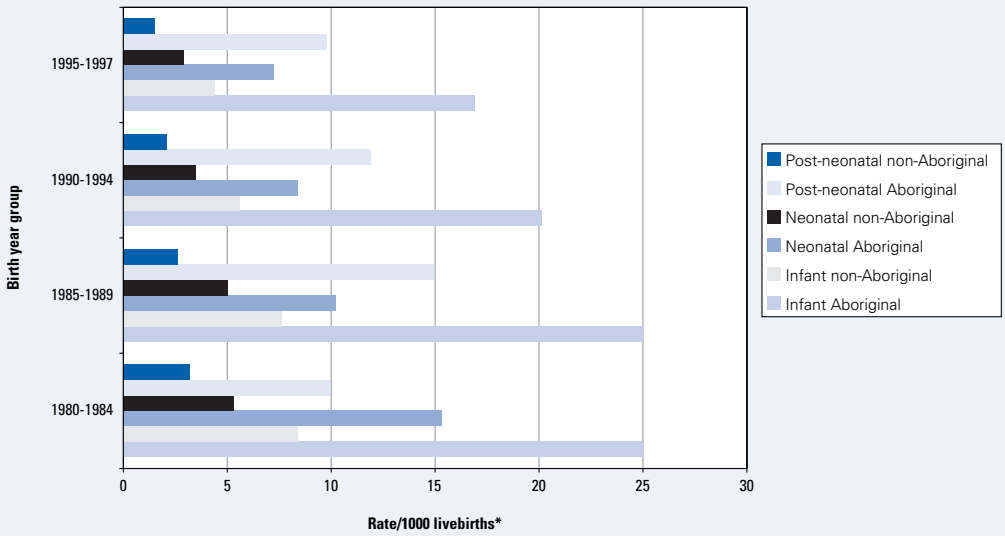
* Some of the increase in the disparity in the post-neonatal period was due to the significant decrease among the non-Aboriginal population, and a corresponding increase in the Aboriginal population of infant mortality attributed to SIDS.

Results

Between 1980 and 1998, 6% of livebirths were to Aboriginal mothers. However, Aboriginal deaths represented 16% of all infant deaths in WA during these years. The CMR for indigenous infants (22/1,000 livebirths) between 1980 and 1997 was significantly higher than their non-Aboriginal peers (6.7/10,000 livebirths) for the same period (RR=3.3, CI 3.0, 3.6).

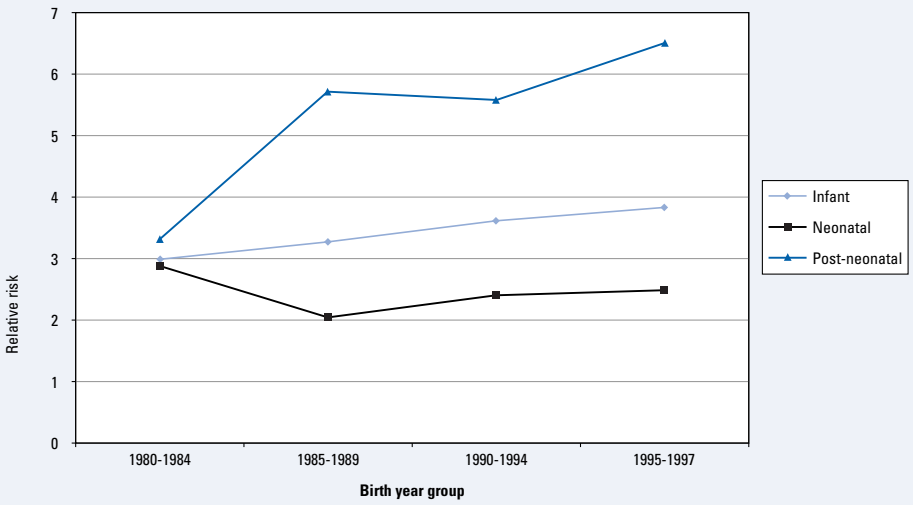
The following figures identify the trends in mortality for WA-born Aboriginal and non-Aboriginal infants between 1980 and 1997 inclusive. Whilst there has been a decrease in the CMR for both Aboriginal and non-Aboriginal infants between 1980 and 1998, the disparity between the two populations has increased. Of particular concern is the size of the relative risk in the post-neonatal period, which increased from 3.3 in 1980-84 to 6.5 in 1995-97. On the other hand, the disparity in the neonatal mortality rate has decreased from 2.9 in the 1980-84 birth cohort, to 2.5 in the 1995-97 birth cohort. The other point of concern is the higher CMR in the post-neonatal period compared with the neonatal period among Aboriginal infants. This pattern is not observed among non-Aboriginal infants.

Figure 1: CMR of Aboriginal and non-Aboriginal infants according to death type and birth year group, 1980 to 1997 inclusive.



* post-neonatal rate per 1,000 neonatal survivors.

Figure 2: Risk of death in the 1st year of life for Aboriginal infants (compared with non-Aboriginal) by birth year group and death type, 1980 to 1997 inclusive.



Infant mortality according to gestational age

The risk of infant mortality for all gestational ages decreased significantly for Aboriginal and non-Aboriginal populations for babies born prematurely. For babies born at term, there was a 10% decrease (non-significant) for Aboriginal babies and a 22% decrease (significant) for non-Aboriginal babies in infant mortality.

There was no significant difference in infant mortality between Aboriginal and non-Aboriginal infants in very preterm infants (<32 weeks).

The relative risk of mortality for an Aboriginal infant (compared with a non-Aboriginal infant) born at term increased from **3.2 (95% CI 2.5, 4.2)** in 1980 to 1984, to **5.4 (95% CI 3.1, 7.7)** in 1995-97.

Geographical location

Over the two decades of the study, there was a higher risk of infant mortality for Aboriginal versus non-Aboriginal infants in all geographical locations, but the disparity of higher risk in Aboriginal infants (compared with non-Aboriginal infants) has particularly increased for infants in remote locations.

Cause specific mortality

When comparing groups by cause of death, the risk of mortality was higher in Aboriginal than non-Aboriginal infants for all major categories, with a much greater disparity for those due to potentially preventable causes, namely infection and SIDS.

CMR (number of deaths) for Aboriginal and non-Aboriginal infants, and RR (95%CI) for Aboriginal infants in birth year cohorts, by causes of infant death, 1980-1997 inclusive.

Cause of death	Aboriginal		Non-Aboriginal		Relative Rate	
	CMR	(N)	CMR	(N)	RR	(95%CI)
SIDS						
1980-1984	4.5	(25)	1.7	(183)	**2.6**	**(1.0, 3.9)**
1985-1989	9.0	(60)	1.7	(195)	**5.3**	**(4.0, 7.1)**
1990-1994	6.2	(45)	1.1	(135)	**5.4**	**(3.9, 7.6)**
1995-1997	4.7	(21)	0.7	(47)	**7.2**	**(4.3, 12.0)**
(p)	*(0.70)*		***(<0.01)****			
Infection						
1980-1984	6.3	(35)	0.9	(98)	**6.8**	**(4.6, 9.9)**
1985-1989	6.5	(43)	0.6	(66)	**11.5**	**(7.7, 16.5)**
1990-1994	6.9	(50)	0.8	(92)	**8.9**	**(6.3, 12.5)**
1995-1997	5.6	(25)	0.7	(49)	**8.2**	**(5.1, 13.3)**
(p)	*(0.73)*		***(0.19)***			
Prematurity						
1980-1984	4.3	(24)	2.3	(241)	**1.9**	**(1.2, 2.9)**
1985-1989	3.8	(25)	2.3	(258)	**1.7**	**(1.1, 2.5)**
1990-1994	3.0	(22)	1.3	(160)	**2.2**	**(1.4, 3.5)**
1995-1997	1.4	(6)	1.3	(89)	**1.1**	**(0.5, 2.5)**
(p)	*(<0.01)**		***(<0.01)****			
Birth defects						
1980-1984	4.5	(25)	2.2	(230)	**2.1**	**(1.4, 3.1)**
1985-1989	3.2	(21)	2.2	(250)	**1.5**	**(0.9, 2.3)**
1990-1994	2.5	(18)	1.5	(180)	**1.6**	**(1.0, 2.7)**
1995-1997	2.9	(13)	1.1	(81)	**2.6**	**(1.4, 4.6)**
(p)	*(0.10)*		***(<0.01)****			

x^2 (1df) for decreasing trend of CMR

Within the Aboriginal population, infants in a remote location were at a significantly increased risk of death from infection compared with their Aboriginal peers in a metropolitan location. There were no other differences in the risk of death according to geographical location for any other cause of infant mortality.

Within the non-Aboriginal population, infants were significantly more likely to die from SIDS in rural areas and significantly more likely to die from infection in remote locations, than in the metropolitan area.

Key summary points

There was a decrease in the cumulative infant mortality rate in the total WA population.

There was a higher risk of mortality in Aboriginal versus non-Aboriginal infants due to an increased risk of death in the post-neonatal period.

There was a greater disparity in potentially preventable mortality (infection; SIDS) in Aboriginal versus non-Aboriginal infants.

References

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2 Stanley F J, Read A, Kurinczuk J, Croft M & Bower C. 1997, A population maternal and child health research database for research and policy evaluation in Western Australia, *Seminars in Neonatology: SN*, vol. 2, no. 3, pp. 195-201

* Aboriginal and Torres Strait Islander people are referred to throughout this paper as "Aboriginal". The author has sought advice on this nomenclature from the Kulunga Research Network, Telethon Institute for Child Health Research.

The Perinatal Autopsy

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The Role of Perinatal Post-Mortems & Services Offered in Western Australia

"It is every parent's right to be offered a post-mortem examination of their child, and equally their right to refuse"

In Western Australia we have one of the highest rates of post-mortem examinations in the country, with around 55% of perinatal deaths assessed, although this figure seems to have declined a little over recent years. During the Committee meetings, the post-mortem examination has often provided useful information for the assessment of the causes of death, and this has been formally assessed in this document.

Is the autopsy still useful?

The post-mortem examination significantly affects the overall understanding of the cause of a perinatal death. Recent series of post-mortem examinations on neonates have shown that in somewhere between 30% and 50% of cases significant information is gained, and this leads to a change of classification in around 20% of cases.

Recent publications have examined whether the post-mortem examination is still useful or can be supplanted by other examinations such as magnetic resonance imaging (MRI). The overwhelming consensus is that the full post-mortem examination still provides more information than available from other techniques, although investigations such as MRI may be very useful for assessing neurological conditions.

Recent studies have also shown that, in general, parents are more likely to regret not having an autopsy than to regret having an autopsy of their baby. Many wish to understand as much as possible why the tragedy occurred.

Coronial autopsies

The Coroner may request an autopsy. The Coroner's office should be contacted for any reportable death (Coroner's Act 1996), such as a death related to anaesthetic, following an injury, or an unexpected death, such as SIDS. It is worth discussing any case with the Coroner's Office if there is any doubt. These autopsies do not require consent, although there are legal means for parents to object to the examination. The Coronial examination is usually undertaken at the state mortuary, Pathcentre, by the Coroner's pathologists.

Non-coronial, consented autopsies

Fetal and most perinatal autopsies are performed at King Edward Memorial Hospital for Women (KEMH) by one of the two perinatal/paediatric pathologists. Cases are transferred from all over the state and returned usually within two to three working days. The perinatal pathology technician (phone 9340 2730) is available for details on forms, transport advice and other information. This service includes mementoes (such as handprints, social photographs), as well as the autopsy with medical photographs and radiology. With parental consent, stillborn babies less than 28 weeks gestation can be cremated, and the individual's ashes retained.

Some infants and older children have autopsies at Princess Margaret Hospital for Children (PMH), where the paediatric pathology technician (phone 9340 8619) may be contacted for information and forms.

The autopsy – full or limited?

The formal autopsy involves examination of the cranial contents, the abdomen and the thorax, with the placenta being a particularly important part of any perinatal examination. Many parents

consent to this, however some request that the brain is not examined. Obviously this may affect the diagnosis. Some parents will ask that only a particular system is examined, or that a step-wise approach is taken where the examination stops when an adequate cause of death is established. In practice in perinatal cases this is not often clear macroscopically.

Some parents do not wish for any incisions, but an external examination, with weight, measurements, radiology, pictures in case of genetic review, and an examination of the placenta can be helpful.

No whole major organ is retained (i.e. brain, heart, lungs, liver or kidneys) without specific consent. In cases of abnormal CNS development or a complicated cardiac defect, it is useful to obtain consent for retention for a better examination.

Unless there is an objection, small pieces of the major organs are routinely taken for histology. Small samples may be taken for other investigations (e.g. microbiological, metabolic, cytogenetic) as appropriate.

The consent for autopsy (non-coronial)

The current law in WA, with the recent rules of practice, means that the consent form is detailed, covering the full or limited examination and clearly indicating parents' wishes. If an organ is to be retained there needs to be a plan if there is to be a delay in burial of the body, allowing the return (usually after a week or so) of the organ. The organ can be cremated and returned, or donated for research or teaching. There are also places on the form for consent for tissue to be retained for teaching or research.

The consent form needs to be signed by a parent. The referring clinician (or midwife) can provide clinical information. The Human Tissue Act officer for the institution needs to sign that there is satisfactory evidence of parental consent, and the post-mortem coordinator also signs the form.

Other Forms

The certificate of stillbirth or neonatal death needs to be completed and, if appropriate, cremation paperwork.

The autopsy report (non-coronial)

A typed macroscopic report is available within two working days and a full report including ancillary investigations and conclusions usually within six weeks. This report can be provided to the parents, but there is also the provision of a plain language report for the parents, to be given after discussion by the clinician.

Interpreting the autopsy report

The pathophysiology of perinatal death is complicated and much research is needed in this area. The best way to investigate a perinatal death undoubtedly involves a review of all the clinical investigations, together with the pathology reports. Often the autopsy finds a complete explanation of the cause of death, but frequently there is only a partial explanation, such as unexpected growth restriction or placental abnormality.

There are also a number of cases where, to the frustration of all concerned, no significant abnormalities are identified at autopsy. Recently diseases such as obstetric cholestasis are being recognised with a high incidence of stillbirth at term, but with no post-mortem features. The post-mortem examination is not good at detecting transient physiological mechanisms. The purpose of the autopsy is to exclude many potential recurrent conditions.

Concluding comments

Assistance

The perinatal/paediatric pathologists at KEMH/PMH are available to discuss cases (9340 8279).

Follow up

KEMH has a multidisciplinary perinatal loss clinic, consisting of a fetal medicine specialist, neonatologist, pathologist, research midwife, social worker, psychologist and chaplain. The aim is to support and counsel parents, investigate if appropriate using various protocols for the different modes of perinatal loss, and also to provide support for health workers. Telehealth facilities are sometimes used for rural hospital links. The contact person is the Coordinator, Perinatal Loss Clinic, (9340 2222 pager 3430, or 9340 2128 answering machine). Counselling services are also arranged through Social Work Department (9340 8222).

PMH also provides support following infant deaths through the relevant clinical team.

Pamphlets for parents and healthcare workers are available from KEMH (9340 2730) and PMH (9340 8619).

Approved multi-lingual copies of the **Post Mortem Examination Consent Form** and the **Non-Coronial Post Mortem Examinations, Information for Relatives** booklet are available on the web at: *http://www.health.wa.gov.au/postmortem/*

We are grateful to the health professionals who have spent their time counselling parents to obtain consent and provide feedback to facilitate this service.

Appendices

Appendix I: Extract from the *Health Act 1911*

Section 340AB. Constitution and offices of Committee

(1) For the purposes of this Part a body to be called the "Perinatal and Infant Mortality Committee" and having the functions prescribed by this Part shall be constituted as provided in this section.

(2) The Minister shall appoint 6 persons to be permanent members and 4 persons to be provisional members of the Committee, and 8 of those persons appointed, namely, the 6 permanent members and 2 of the provisional members selected in accordance with section 340AK(1), shall constitute the Committee.

(3) *Of the 6 persons appointed as permanent members of the Committee –*

(a) one shall be the Professor of Obstetrics of the University of Western Australia;
(b) one shall be a medical practitioner nominated by the Commissioner;
(c) one shall be a medical practitioner specialising in neonatal paediatrics at King Edward Memorial Hospital nominated by the Hospital Board of that hospital;
(d) one shall be a medical practitioner specialising in neonatal paediatrics at Princess Margaret Hospital for Children nominated by the Hospital Board of that hospital;
(e) one shall be a general medical practitioner having not less than 5 years practice outside the metropolitan area, nominated by the State Branch of the Australian Medical Association; and
(f) one shall be a medical practitioner specialising in Clinical Epidemiology nominated by the Commissioner.

(4) *Of the 4 persons appointed as provisional members of the Committee –*

(a) one shall be a medical practitioner specialising in obstetrics and perinatal care, nominated by the Australian College of Obstetricians and Gynaecologists (W.A. Branch);
(b) one shall be a general medical practitioner with special interest in perinatal care, nominated by the State Branch of the Royal Australian College of General Practitioners;
(c) one shall be a general medical practitioner, nominated by the Commissioner; and
(d) one shall be a midwife in clinical practice nominated by the State Branch of the Royal Australian Nursing Federation.

(5) The chairman of the Committee shall be appointed by the Minister from amongst the persons who are permanent members of the Committee.

Further information regarding the regulation of the Perinatal and Infant Mortality Committee is found in the following relevant sections of the *Health Act 1911*:

340 AC. Appointment of deputies
340 AD. Nominations to be made to Minister
340 AE. Tenure of office
340 AF. When office of member becomes vacant.
340 AG. Vacancies in offices of members to be filled
340 AH. Quorum
340 AI. Reimbursement of expenses of members
340 AJ. Appointment of investigator
340 AK. Functions of Committee
230 AL. When report may be published
340 AM. Information for research not to be disclosed
340 AN. Regulations as to Perinatal and Infant Mortality Committee

The Health Services (Quality Improvement) Act 1994: This Act has effect despite the *Freedom Of Information Act 1992.*

Appendix II: Perinatal Deaths by PSANZ-PDC, WA 2000-01

PSANZ-PDC CODE	All	Type of Death			
		SB	NND	PND	PNND
1. CONGENITAL ABNORMALITY	**151**	**97**	**38**	**135**	**16**
1.1 Central Nervous System	30	**21**	**4**		**5**
1.2 Cardiovascular System	29	13	11		5
1.3 Urinary Tract	9	6	3		.
1.4 Gastrointestinal Tract	1	1	.		.
1.5 Chromosomal	32	25	7		.
1.6 Metabolic	1	.	.		1
1.7 Multiple	22	15	5		2
1.8 Other Congenital Abnormality	8	3	3		2
1.81 Musculoskeletal	4	3	1		.
1.88 Other Specified Congenital Abnormality	15	**10**	**4**		**1**
2. PERINATAL INFECTION	**30**	**12**	**15**	**27**	**3**
2.11 Group B Streptococcus	8	4	3		1
2.12 E Coli	3	1	2		.
2.13 Listeria Monocytogenes	3	**3**	.		.
2.18 Other Bacterial	7	1	6		.
2.19 Unspecified Bacterial	1	.	1		.
2.21 Cytomegalovirus	1	1	.		.
2.22 Parvovirus	1	1	.		.
2.28 Other Viral	2	.	.		2
2.5 Fungal	2	.	2		.
2.8 Other	1	.	1		.
2.9 Unspecified Organism	1	**1**	.		.
3. HYPERTENSION	**19**	**16**	**2**	**18**	**1**
3.2 Chronic Hypertension: secondary	1	1	.		.
3.4 Gestational Hypertension	1	1	.		.
3.5 Pre-eclampsia	16	13	2		1
3.6 Pre-eclampsia superimposed on chronic hypertension	1	**1**	.		.
4. ANTEPARTUM HAEMORRHAGE (APH)	**48**	**37**	**9**	**46**	**2**
4.1 Placental Abruption	39	30	7		2
4.2 Placenta Praevia	1	.	1		.
4.3 Vasa Praevia	1	.	1		.
4.8 Other APH	4	4	.		.
4.9 APH of Undetermined Origin	3	3	.		.
5. MATERNAL CONDITIONS	**23**	**19**	**2**	**21**	**2**
5.1 Termination of Pregnancy (Other than for congenital abnormality)	2	**1**	**1**		.
5.2 Diabetes / Gestational Diabetes	9	7	.		2
5.31 Maternal Injury (accidental)	3	3	.		.
5.4 Maternal Sepsis	1	1	.		.
5.8 Other Maternal Conditions	8	7	1		.
6. SPECIFIC PERINATAL CONDITIONS	**44**	**35**	**9**	**44**	**0**
6.1 Twin-twin Transfusion	9	8	1		.
6.2 Fetomaternal Haemorrhage	5	5	.		.
6.3 Antepartum Cord Complications	7	6	1		.
6.4 Uterine Abnormalities	11	10	1		.
6.5 Birth Trauma	3	.	3		.
6.7 Idiopathic Hydrops	2	2	.		.
6.8 Other Specific Perinatal Conditions	7	4	3		.

PSANZ-PDC CODE	All	Type of Death			
		SB	NND	PND	PNND
7. HYPOXIC PERIPARTUM DEATH	**19**	**13**	**6**	**19**	**0**
7.1 With Intrapartum Complications	5	3	2		.
7.18 Other	1	.	**1**		
7.2 No Apparent Complications	3	1	2		.
7.9 Unspecified Hypoxic Peripartum Death	10	9	1		.
8. FETAL GROWTH RESTRICTION	**24**	**24**	**0**	**24**	**0**
8.1 With Evidence of Uteroplacental Insufficiency	11	11	.		.
8.2 With Chronic Villitis	1	1	.		.
8.3 Without the Above Placental Pathology	8	8	.		.
8.4 No Examination of the Placenta	4	**4**	.		.
9. SPONTANEOUS PRETERM	**97**	**40**	**50**	**90**	**7**
9.11 Intact Membranes or Rupture within 24hrs of delivery, with Chorioamnionitis	2	1	1		.
9.12 Without Chorioamnionitis	3	1	2		.
9.13 No Examination of the Placenta	1	.	1		.
9.19 Unspecified or Not Known Whether Placenta Examined	2	2	.		
9.21 With Membrane Rupture >24hrs before delivery, with Chorioamnionitis	10	2	8		.
9.22 Without Chorioamnionitis	1	.	1		.
9.29 Unspecified or Not Known Whether Placenta Examined	3	2	1		
9.31 With Membrane Rupture of unknown duration before delivery, with Chorioamnionitis	13	8	5		.
9.32 Without Chorioamnionitis	3	2	1		.
9.33 No Examination of the Placenta	1	.	1		.
9.39 Unspecified or Not Known Whether Placenta Examined	58	22	29		7
10. UNEXPLAINED ANTEPARTUM DEATH	**79**	**79**	**0**	**79**	**0**
10.1 With Evidence of Uteroplacental Insufficiency	4	4	.		.
10.2 With Chronic Villitus	2	2	.		.
10.3 Without the Above Placental Pathology	43	43	.		.
10.4 No Examination of Placenta	10	10	.		.
10.9 Unspecified / Unexplained Antepartum Death or Not Known Whether Placenta Examined	20	20	.		.
11. NO OBSTETRIC ANTECEDENT	**59**	**0**	**6**	**6**	**53**
11.11 Consistent with SIDS	21	.	1		20
11.12 Possible SIDS	5	.	.		5
11.2 Postnatally Acquired Infection	9	.	.		9
11.3 Accidental Asphyxiation	6	.	1		5
11.4 Other Postnatal Accident, Poisoning or Violence	4	.	.		4
11.8 Other	5	.	.		5
11.9 Unknown / Unexplained	9	.	4		5
12. NOT CLASSIFIED OR NOT APPLICABLE	**1**		**1**	**1**	**.**
9.9 Information Too Sparse to Classify	1	.	1		.

Abbreviations:

SB = Stillbirths
NND = Neonatal deaths
PND = Perinatal deaths (Stillbirths and Neonatal deaths combined)
PNND = Post-neonatal deaths

Appendix III: Infant Deaths by PSANZ-NDC, WA 2000-01

PSANZ-NDC CODE		Type of Death		
		NND	PNND	All
1.	**CONGENITAL ABNORMALITY**	**36**	**16**	**52**
1.1	Central Nervous System	4	5	9
1.2	Cardiovascular System	11	5	16
1.3	Urinary Tract	3	.	3
1.5	Chromosomal	7	.	7
1.6	Metabolic	.	1	1
1.7	Multiple	4	2	6
1.8	Other Congenital Abnormality	7	3	10
2.	**EXTREME PREMATURITY**	**41**	**0**	**41**
2.1	Not Resuscitated	8	.	8
2.2	Unsuccessful Resuscitation	15		15
2.9	Unspecified or Not Known Whether Resuscitation Attempted	18		18
3.	**CARDIO-RESPIRATORY DISORDERS**	**18**	**5**	**23**
3.1	Hyaline Membrane Disease / Respiratory Distress Syndrome	7	1	8
3.4	Pulmonary Hypoplasia	6	1	7
3.5	Chronic Neonatal Lung Disease	2	2	4
3.8	Other	3	1	4
4.	**INFECTION**	**12**	**11**	**23**
4.11	Congenital Bacterial	4	.	4
4.12	Acquired Bacterial	5	5	10
4.21	Congenital Viral	.	1	1
4.22	Acquired Viral	1	3	4
4.5	Fungal	2	.	2
4.8	Other	.	1	1
4.9	Unspecified Organism	.	1	1
5.	**NEUROLOGICAL**	**18**	**3**	**21**
5.1	Hypoxic Ischaemic Encephalopathy / Perinatal Asphyxia	12	2	14
5.2	Intracranial Haemorrhage	6	.	6
5.8	Other	.	1	1
6.	**GASTROINTESTINAL**	**4**	**5**	**9**
6.1	Necrotising Enterocolitis	4	4	8
6.8	Other	.	1	1
7.	**OTHER (INC SIDS)**	**8**	**44**	**52**
7.1	SIDS	.	1	1
7.11	Consistent with SIDS	1	19	20
7.12	Possible SIDS	.	6	6
7.2	Multisystem Failure		1	1
7.3	Trauma	.	1	1
7.8	Other	1	10	11
7.9	Undetermined / Unknown	6	6	12
8.	**NOT CLASSIFIED OR NOT APPLICABLE**	**1**	**0**	**1**
9.9	Information Too Sparse to Classify	1	0	1

Classification Systems for Cause of Death: Explanatory Notes[11]

Formerly, Western Australia had adopted the Queensland classification system – Queensland Council on Obstetric and Paediatric Morbidity and Mortality (QCOPMM). Following this, the Whitfield classification system was used.

A number of discussions were held between 1996 and 2000 with interested parties, including input from the Perinatal Society of Australia and New Zealand (PSANZ). This led to the Perinatal Data Development Committee (PDDC) recommendations of the use of two classification systems: the Australian and New Zealand Antecedent Classification of Perinatal Mortality (ANZACPM) and the Australian and New Zealand Neonatal Death Classification (ANZNDC). These were endorsed by the PDDC in March 2000. In March 2003 they were re-named in recognition of the official formation of the Perinatal Mortality Classification Special Interest Group of the PSANZ to become the Perinatal Society of Australia and New Zealand Perinatal Death Classification (PSANZ-PDC) and the Perinatal Society of Australia and New Zealand Neonatal Death Classification (PSANZ-NDC). With the re-naming came minor additions to the classification system.

The PSANZ-PDC is a 4 digit numeric coding system intended for use in a hierarchical manner in relation to its major categories, but not within subcategories. Thus Category 1, Congenital Abnormality, if present, would take precedence over other categories. Category 3, Hypertension, includes deaths where the hypertensive disorder is considered the factor initiating the chain of events leading to the death. If placental abruption complicates a hypertensive disorder, the death is classified under Category 3, as the abruption is attributed to the hypertensive disorder. This category excludes the circumstance when the hypertension is secondary to an underlying systemic disorder, e.g. diabetes, where this is severe and uncontrolled (in which case it is to be coded as 5.2 diabetes, under Maternal Conditions). However, if the systemic disorder such as diabetes is mild or well controlled, and the death appeared to be due to hypertension or its complications, it is still coded in the Hypertension Category 3. This category also includes hypertension secondary to renal disease, as this often presents first with hypertension.

Thus, although the numbering of main groups of causes of death is hierarchical in general, in some cases this hierarchical system may not apply, as in the relationship between Maternal Conditions and Hypertension or APH, and each case may need to be coded according to its own particular clinical circumstances.

The PSANZ-NDC is not intended for use in a hierarchical manner, with the exception of Category 1 which is also Congenital Abnormality, in keeping with ANZACPM, and which takes precedence over other categories. The PSANZ-NDC is a 3 digit numeric coding system.

Opportunities are provided in Addendum 1 after PSANZ-PMC for special interest groups to use the free 4th digit in some categories, e.g. in categories 3 (Hypertension), 4 (Antepartum Haemorrhage), 8 (Fetal Growth Restriction) and 10 (Unexplained Antepartum Death) to identify risk factors such as the thrombophilias, substance abuse and alcohol, which are not considered to be the cause of death, but are associated with it. Similarly, Addendum 2 after PSANZ-NDC provides an opportunity to code more specifically for subtypes or complications associated with Respiratory Distress Syndrome under Category 3 and Cardio-respiratory Disorders. For reporting at the national level, the main PSANZ-PDC and PSANZ-NDC classifications will be used.

Reference

Maternal and Perinatal Mortality Audit: guidelines for Queensland Hospitals, Jan 2001, and PSANZ website, version 23/5/03.

Appendix IV: Rating System: Evidence-Based Medicine (EBM)

Quality of Evidence

Ia Evidence obtained from meta-analysis of randomised controlled trials.

Ib Evidence obtained from at least one randomised controlled trial.

IIa Evidence obtained from at least one well designed controlled study without randomisation.

IIb Evidence obtained from at least one other type of well-designed quasi-experimental study.

III Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.

IV Evidence obtained from expert committee reports or opinions and/or clinical experience of respected authorities.

Strength of Recommendation

Level A At least one randomised controlled trial as a part of a body of literature of overall good quality and consistency addressing the specific recommendation. (Evidence levels 1a, 1b)

Level B Well-controlled clinical studies available but no randomised clinical trials on the topic of recommendations. (Evidence levels IIa, IIb, III)

Level C Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates an absence of directly applicable clinical studies of good quality.

√ good practice point – recommended best practice based on the clinical experience of the guideline development group.

Reference

James D, Stone P, et al. Evidence-Based Obstetrics, Saunders 2003

Department of Health
Government of Western Australia

HP 2219 APRIL'05 JN 19648